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31 OCTOBER 1991



# ***JPRS Report***

# **Science & Technology**

***Europe***

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# Science & Technology

## Europe

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## AEROSPACE

### ESA Members Discuss Future Development, Costs of Hermes, Columbus

92WS0036A Paris *LE MONDE* in French  
29-30 Sep 91 p 9

[Article by special correspondent in Florence Jean-Paul Dufour: "European Space Program: Difficult Gestation for Hermes and Columbus"; first paragraph is *LE MONDE* introduction]

[Text] Representatives of the 13 European Space Agency (ESA) member countries met in Florence on Friday, 27 September, to discuss the future of the Hermes spacecraft and the Columbus European orbital station program.

Less than two months before the ministers meeting scheduled for 18-19 November in Munich, discussions on the future of the European space program are getting ever fiercer. Faced with budget and political problems, the ESA member states are negotiating every detail of the financing of a costly program (over 200 billion French francs [Fr] with Ariane-5) which is the subject of much criticism from parliament members, as they worry about increasing unemployment or, in Germany, about the cost of reunification.

Some do not rule out a further delay in the Hermes and Columbus programs, in order to spread expenditures over a longer period of time and thus make them more bearable. Mr. Hubert Curien himself, the French minister of research and technology, representing one of the leading sponsors of these programs, is no longer excluding this possibility. An additional delay of one year, or even one year and a half, in the Hermes and Columbus programs might then be added to the postponements already decided seven months ago (*LE MONDE*, 5 March).

Thus, the first element of the Columbus station would not fly before 1998. As for Hermes, a working group met from 30 August to 1 September in Darmstadt (Germany) to define a "scenario." It provides for a first unmanned flight of the spacecraft in April 2002, with the second—manned—flight by mid-2003.

Given this new postponement, the development cost of Hermes would amount to 6.2 billion accounting units under 1986 economic conditions (49.5 billion of today's francs), i.e., a Fr2.05-billion increase, as Mr. Jorg Feustel-Bueechl, ESA director of space transport systems, announced at a press conference in Florence (Italy) on 27 September. This "working hypothesis" may still change, but "an additional rescheduling would throw the very program back into question," Mr. Feustel-Bueechl estimated.

The politicians will decide in Munich. However, experts display moderate optimism, like Mr. Quiles, minister of equipment and space, who recently stated that France

"favors the development of a large European space program, but not by all means or at all costs."

### ESA Initiates Payload Capsule Study

92WS0001D Bonn *LUFT- UND RAUMFAHRT*  
in German Jul-Aug 91 p 9

[Article: "ESA Awards Payload Capsule Study to MAN"]

[Text] The ESA has awarded a contract to the MAN Technologie company for a definition study for Europe's own payload capsule. According to MAN Technologie, with the development of such a capsule, the ESA would be independent of the American, Soviet, and Chinese space agencies and would gain the capability of launching European experiments on a schedule corresponding to national interests.

Along with CNES, MAN Technologie designed this capsule and submitted a planning study to ESA at the end of 1990. The goal of the planning of the "Eurocapsule" was the system-based design on the future European launcher Ariane V so that the capsule with a payload of 400 to 900 kg can be transported as a kind of "supplemental load" with the satellites, which would significantly reduce the relative costs.

In the first step, the Ariane capsule is technologically handled by France and Germany. For this, the distribution of tasks is based on the existing technological potential in these two countries. The French responsibility lies in the area of the heat shield which is based on conventional ablative technology. On the German side, in addition to leadership of the study, in which 14 companies are currently participating, MAN Technologie is undertaking the planning of the operation of the capsule as well as the creation of a development and operational model in the form of a business plan.

### Fate of Hermes Project Called 'Uncertain'

91WS0542A Stuttgart *FLUG REVUE*  
in German Sep 91 pp 18-22

[Article by Gotz Wange: "Hermes at the Crossroads"]

[Text] The industry is at the end of its tether. The European space shuttle Hermes will be at least one-third more expensive than agreed to at The Hague in 1987. Theoretically, Germany could bail out of the program—an outcome demanded by critics. Then, however, the entire space-travel strategy of the Europeans would collapse. For this reason, a positive decision is expected at the European Space Agency (ESA) ministerial committee conference scheduled for November in Munich.

Hermes long ago became a red flag to every politician in the German Bundestag for whom numbers are more important than content. They openly demand a drastic reduction of the spending for manned space flight. Criticism is much easier in this case because the French

are acting as the main contractor for Hermes. A fact overlooked is that without approval for the space shuttle Hermes, there will also be no approval for the space-station program Columbus. The Germans are running that project. "The large-scale programs of the ESA are like a three-legged table," says Helmuth Dederra, describing an example. "If you shorten one leg, the entire table wiggles." Dederra is responsible for sales and programs of the space shuttle systems and drive systems for the Deutsche Aerospace group (DASA) in Ottobrunn.

According to the letter of the law, the Federal Republic could withdraw from participation. This course of action becomes possible for large-scale ESA projects whenever actual costs exceed the calculated costs by 20 percent. For Hermes, the calculated costs have, in the meantime, been exceeded by more than 30 percent. Instead of 8.8 billion marks, a figure of 11.6 billion marks (in 1986 marks) is under discussion for the space shuttle. So at least the annual budget burden could be smaller, the program is to be stretched out. Will Hermes not lift off on its maiden, still unmanned, space flight until 2000/2001, rather than in 1998.

The avenue of realizing additional savings in the Hermes design is no longer available. Every possibility appears exhausted with the technology available in Europe today. One clear sign is that, instead of the originally intended 15 metric tons, a fully equipped space shuttle weighs 22.4 metric tons today. This exceeds the capacity of the Ariane 5 launch vehicle. "They will launch into space with a negative payload," comment the malicious critics.

The Hermes managers can escape this dilemma for the moment only by reaching into their bag of tricks. Hermes' maiden space flight is to run automatically and without a crew. This flight will omit all technical equipment specially necessary for later manned use. At the ESA, discussions center on a configuration that contains the supply module built by DASA and mounted on the aft section of the space shuttle. However, for example, the coupling nozzle for docking with the free-flying space laboratory Columbus will not be present. "The space laboratory will not even be in orbit then," runs the argument of the responsible ESA director Jorg Fuestel-Buechl. Even the robot arm HERA, to be delivered to the Columbus laboratory, can remain on the ground. In the Hermes cockpit, the ejector seats and even parts of the life-support system will be omitted.

Hermes can only lift off completely equipped and with three astronauts on board when the Ariane 5 launch vehicle has more power. An improvement of the turbo pump for liquid oxygen on the engine of the middle stage is under consideration. With this change, the thrust of the Vulcain drive could increase from 1000 kN to 1300 kN. However, the drive-system expert Dederra is not quite so pessimistic even before this improvement. "Experiments using the Vulcain on a test stand have

already shown that the specific performance will be higher than designed. This adds about 500 kg of payload capacity."

Kuno Schneider is responsible for all Hermes activities at DASA. The problems with the Hermes space shuttle do not surprise him. "For cost reasons, the ESA wanted to drop a special launch vehicle for manned space flight. This made compromises unavoidable for the Ariane 5/Hermes combination," he reminisces. The main function of Ariane 5 is to transport satellites. This meant the space shuttle had to be mounted on the top of the middle stage rather than on the side. A side mounting would have been better from an aerodynamic perspective. This mounting location forced a reduction in the wing area of Hermes to 80 square meters to present as little area as possible to shear winds during lift-off. The result of this is that, when returning to Earth, the design wing loading permits only a limited landing weight. While the shuttle may deliver three metric tons to the space station, it can only bring 1.5 metric tons of equipment and samples back.

#### Model Tests in Germany and Italy

An independent commission recently blessed the Hermes design although there is still some homework to be done for the thermal protection and fuel cells. MAN is providing the insulation packets and Siemens is working on the fuel cells. The task of the computer experts in handling the flood of data is also not easy. ANT is responsible for designing the subsystems for data acquisition and communications.

Although Aerospatiale in Toulouse will handle integration of the space shuttle, Hermes will first show its contours in Germany. DASA is building the "cold structure." This is the rump of the space shuttle without thermal protection. DASA also will run appropriate static tests using a model. Alenia Spazio in Italy will use the same model for the thermal tests. This company is developing the thermal control systems.

Schneider from DASA was one of the German delegates in Toulouse. Then, he, together with his colleagues, helplessly stood by as the French completely defeated the program by a majority vote. He is now again full of hope. The founding of the Euro-Hermespace company is to create integrated European industrial teams. Of course, this is only when the ESA ministerial committee gives its approval for the space shuttle. However, there is no doubt about this.

#### Hermes on Hold, Companies Renegotiate Space Station Contract

92WS0009A Duesseldorf VDI NACHRICHTEN  
in German 6 Sep 91 p 3

[Article by W. Mock: "Hermes in Holding Pattern"; first two paragraphs are VDI NACHRICHTEN introduction]

[Text] Duesseldorf, 6 Sep (VDI-N)—Space: Financial difficulties make new designs essential. German industry must renegotiate the distribution of tasks in the construction of the space station.

The European space shuttle should be trimmed back to a technology project. The decision as to whether it will ever be built can be postponed until 1995. As a result, the timetable for the Columbus space station is thrown completely off, with significant consequences for the German space industry.

For more than a year, Wolfgang Wild, head of the German space agency DARA, and his employees have been fine tuning the proposal for a new space program. They wanted to spend 25 billion German marks [DM] by the year 2000 to conquer space. The draft was ready in the spring, but on 10 July of this year "most of it was still just wastepaper" (according to Wild).

Why? Federal Minister for Research Heinz Riesenhuber had presented the budget for his ministry for the year 1992. Even to cover Wild's plans for the year 1992, Riesenhuber lacked DM200 million. And by the year 2000, the gap in coverage between planned spending for space and the funds provided in the space budget would have increased to more than DM6 billion.

In a series of crisis sessions with the German space industry, the specialists from DARA and the Federal Ministry for Research and Technology (BMFT) are currently looking for a way out of the financial misery. Because time is of the essence: On 18 and 19 November, the space ministers of the member states of the European Space Agency ESA will meet in Munich to decide on the continuation of the large European space projects—the Hermes space shuttle and the Columbus space laboratory module.

In light of its drastic financial difficulties, the German federal government wants to make cuts above all in the Hermes project under French leadership. The Germans, involved in the project at the rate of 27 percent, could even back out of Hermes under ESA regulations, because its costs now stand at 132 percent of the original calculations. However, according to the technical policy spokesman of the CDU/CSU coalition in the German Bundestag, Christian Lenzer, "overriding opinions, particularly in foreign policy" make such a withdrawal rather "improbable."

Therefore, Riesenhuber and Wild want to convince ESA head Jean Marie Luton to postpone the final decision on Hermes construction at least until 1995/96 and to precede it with a—less expensive—technology project. In his draft for the new space program, Wild pointed to the "very high technical risks" in the Hermes project.

"If we had more time," according to sources near BMFT, "we could come to grips with the developmental, cost, and performance risks through this technology project." In 1987 when the ESA ministers decided to build Hermes, it was supposed to cost just under DM8.5 billion;

this has now become more than DM11 billion. Germany would be responsible for almost DM3 billion of this.

Despite the increasing weight of the space shuttle, its payload has dropped to only 1 metric ton, and still, according to a November 1990 study by the German Aerospace Research Institute (DLR), "the flyability of the Hermes configuration over the entire range of speeds is problematic." The hope to be able to increase the payload at least back to 3 metric tons is linked with the technology project.

Hermes first launch, originally planned for the turn of the millenium, would thus have to be postponed to the year 2004/05.

The economic developments of the two large ESA partners Italy and France fit in very well with the German desires for savings. Both countries have clearly lower growth rates in their space budgets than planned, and both are hardly in a position to finance the annual growth rate of up to 10 percent planned by the ESA in the large projects of Hermes and Columbus. Thus, BMFT representatives are already observing in the French and the ESA a "clear accommodation" to the savings plans of the Germans. Additionally, the united front in the ESA is also beginning to crumble. Norway and the Netherlands have been looking for months for opportunities to be able to withdraw from the Hermes project.

If the Germans prevail with their idea of a technology project for Hermes with their ESA partners, the political and economic problems are still far from solved. "Such a project," according to CDU [Christian Democratic Union] politician Lenzer, "would only make sense if the decision whether to actually build Hermes is not made until after the end of the project." However, Wild fears that the French, whose space prestige is closely linked to Hermes, would "hardly permit" such a new basic decision. They want a definitive decision at the ESA ministerial meeting in November as to whether Hermes will be built—with or without a technology project.

If there actually is a technology project, that is when problems will really start for the German industry. MBB-Erno is the prime contractor for the European Columbus space lab, in which the German industry has a 38 percent share. Columbus consists of the lab (APM) solidly docked onto the U.S. space station, the free-flying space lab (MTFF), and a polar observation platform. The Italian industry is responsible for the APM, MBB-Erno in Bremen for the MTFF. This is, however, closely linked from its very design to Hermes, since it is supposed to be serviced by it.

A postponement of Hermes to the year 2005/05 thus entails a postponement of the MTFF, originally planned for 1998. It suddenly cuts the German industry's share in the Columbus space station in the next five years in half.

To guarantee its full utilization, the German prime contractor MBB-Erno is currently negotiating with the

Italians. They must be enticed into giving up a share of their work on the docked module to the Germans, in return for a greater share in the MTFF at a later date. "We also want to be involved at the rate of at least 38 percent, i.e., matching our total participation in Columbus, in the coming years in the development and production of the European space station elements," says DARA employee Helmut Heumann. "But," according to sources at the BMFT, "with the Italians, we are banging our heads against a brick wall."

One solution would be the foundation of a European company Eurocolumbus with a German majority. That would formally recognize the German leadership of the project, and the shares would be easier to shift around within the company. If the European industrial partners Alenia (Italy) and Matra (France) consent, an agreement would be possible in "an extremely short time" (according to Heumann).

#### Photo Caption

The European space shuttle Hermes has overrun its cost limits by 32 percent, and doubts persist as to whether it can ever fly. These doubts should be dispelled with a technology project.

#### WEU Recommends Military Version of A340 Airbus

92WS0001A Bonn LUFT- UND RAUMFAHRT  
in German Jul-Aug 91 p 6

[Article: "WEU Recommends Military Version of A340"]

[Text] At its session on 5 June in Paris, the WEU [Western European Union] recommended construction of a European strategic air transport command to be equipped with a military version of the Airbus A340. A report on the effects of the Gulf War on European arms presented by Sir Dudley Smith of the United Kingdom on behalf of the WEU Committee for Technology, Air, and Space looks at the need to establish a rapid intervention force. In this connection, the possibility of a European fleet of military freight aircraft (Airbus A340) should be studied within the framework of the WEU.

Not so long ago, the use of Airbuses as military transports or tankers would have been rejected by the members of virtually all parties in the Bundestag. Now the Defense Commission of the federal government has issued the following order for study: "The Federal Ministry of Defense is commissioned to investigate how it will be possible to provide suitable air transport space through wide-bodied transport aircraft within the framework of a joint European security policy."

In this process, federal participation in the new acquisition of wide-bodied aircraft by airline companies and community investment of the European states in such a

unified transport fleet as well as the suitability of the Airbus A340 and other transatlantic alternatives are to be investigated.

#### Results of BRITE/EURAM Aeronautics Projects Reported

91WS0539A Brussels IRDAC NEWS in English  
Aug 91 pp 4-6

[Article: "Community R&D Activities in Aeronautics"]

#### [Text] Current Programme of Aeronautical Research

Specific R&D activities in key technology areas of aeronautics at a Community level are relatively young and are reaching their first milestones this year: First technical results were presented during an aeronautics conference in April, and a follow-on phase is envisaged, with call for proposals in autumn 1991.

In March 1989 the Council of Ministers approved the first specific R&D activity in aeronautics as BRITE/EURAM [Industrial Technologies/Advanced Materials] (program) Area 5. This decision followed the Commission's initiative based on the "EUROMART" study undertaken together with the European aeronautical industry (see IRDAC [Industrial R&D Advisory Committee of the EC Commission] NEWS June 1989).

The Call for Proposals was issued in March 1989 and 112 proposals were received. Of these, 28 were selected for Community support, covering the fields of aerodynamics, acoustics, airborne systems and equipment and propulsion systems. The projects were for two years, with a total Community funding of 35 million European currency units [ECU]. Additionally aeronautical projects are running in BRITE/EURAM Areas 1-4 and cover the field of advanced materials and manufacturing with a total funding of about ECU25 million. In February 1991 the Commission transmitted the Second Year Review Report on BRITE/EURAM, Area 5 Aeronautics (\*) to the Council and the European Parliament stating the need for the continuation and expansion of specific aeronautical activities.

In June 1991 an "Independent Evaluation Panel" recommended in its final report (\*\*) that the Community should adopt a full programme. Optimum efficiency would call for a fully focused and integrated aeronautics research initiative.

#### Aeronautics Days

The first "Aeronautics Days" were held in Brussels on 16 and 17 April 1991 with about 600 participants from 17 countries. They were organised by the Commission as part of its continuing activity to increase collaboration within Europe, and to provide a forum for information exchanges and the establishment of further contacts between all the actors involved.

The opening session "Aeronautics-High Technology Challenge for Europe", was guided by Dr Karl-Heinz

Narjes, former Vice-President of the Commission, who had launched the Commission's initiative in aeronautical research in 1986. He encouraged the Community and European Industry to prepare the future by cooperative efforts and to allocate the necessary priorities, to avoid a common error - doing too little too late. A message from Prof. Hubert CURIEN, French Minister of Research, expressing his support for Community actions in the field of aeronautics was delivered on his behalf by Mr. Andre Dubresson, Director of the Civil Aeronautics Programme at the French Ministry of Transport.

Mr. Fausto Cereti, President of AECMA (Association Europeenne des Constructeurs de Materiel Aeronautique) emphasised the need, as seen by industry, for an increased Community involvement in civil aeronautics research, and for finding new ways of allocating the available resources to common requirements and objectives. Mr. Hartmut Mehdorn, Chairman of Deutsche Airbus and Member of the Executive Board, Airbus Industries, explained the view of the European manufacturers. He stressed the need for cooperation in all areas of aircraft manufacture: development, production, marketing, and for risk-sharing in future developments. He concluded that long-term, technology programmes at a European level are necessary. Such programmes could be coordinated by a "European Aeronautics Agency" following the model of NASA. In the next ten to fifteen years, Deutsche Airbus and its partners could build aircraft, that, compared with current types would consume 40% less fuel and produce 55% fewer emissions under higher safety standards.

Mr. Stewart C. Miller, Managing Director of the Rolls-Royce Aerospace Group, said on behalf of the European aero-engine industry that cooperative research at a European level was indispensable to maintain the long term competitiveness of the European Industry, particularly with regard to developments in the United States and Japan. This opinion was also endorsed by Mr. Jean Monfort, Director General of the French equipment company Sextant Avionique, and Mr. Luigi Di Giorgio, Director for Technology and Fleet Development at Alitalia, who underlined the need for a high technology standard in aeronautics.

#### **Future Requirements and Long Term Priorities in Aeronautics**

The second part of the Aeronautics Days was dedicated to the long-term technology needs and future requirements related to environmental and market aspects. Mr. W. Kroll, Chairman of DLR, the German Aerospace Research Centre, highlighted the effects of air transport on the environment based on a predicted doubling of traffic by the year 2000; especially with regard to aircraft noise, exhaust emissions and the role of new technologies in solving these problems.

Mr. J.P. Roeder, Senior Vicepresident Airbus Industrie, emphasized the requirements for technical superiority.

Future considerations of Airbus Industrie include an ultra-high capacity aircraft for up to 700 passengers to be launched by 1997, and a high efficiency aircraft to go into service around the year 2005. Technology preparation has to start now. He pointed out that joint ventures on a supra-national level have proved to be particularly stable once they are started. This is the case for Airbus, and there is no reason why this should not apply to research within the Communities' aeronautic research initiative.

During a podium discussion with participants from all aeronautical sectors the following key conclusions from the Aeronautics Days were drawn:

- The Aeronautics Pilot Programme has created a substantial mobilisation in Europe;
- The cost effectiveness of new technologies has to be considered;
- A European focus for aeronautical R&D is essential for the long term;
- "Small" Member States also benefit from European Aeronautical Industry activities;
- European cooperation in aeronautics is now effective, but much still remains to be done.

During the Aeronautics Days an exhibition and poster-show demonstrated the high technical level of the aeronautical projects within the BRITE/EURAM programme and gave the opportunity for detailed information exchange: Thirty-eight project teams presented in three parallel sessions their collaborative work and first results (\*\*\*). These projects cover research in aerodynamics, acoustics, airborne systems, equipment and propulsion. In addition, research on advanced materials and on design and manufacturing methods relating to the aeronautical industry was presented.

#### **Typical Projects in the Aeronautical Pilot Programme**

The following three projects are typical examples of European collaboration in the aeronautical Pilot Programme.

**A "Laminar Flow" Wing:** "Laminar flow" is one of the most promising aero-dynamic technologies to reduce drag. Air can flow in a regular (laminar) or turbulent way along the aircraft surface. The more the flow is turbulent the stronger the drag. Conservation of the laminar flow on the wing profile would allow a drag reduction of almost 20%, with substantial savings in fuel consumption. The ELFIN [European Laminar-Flow Investigation] project is aimed at studying this phenomenon and developing laminar flow technologies. It brings together 24 companies and research organisations from 11 countries. The process developed to "laminarise" the flow consists of sucking in the boundary layer through small holes made in the leading edge. Such a wing will be developed and tested for the first time in Europe at the



trans-sonic wind-tunnel in Modane/France. In September 1991 a campaign of flight tests on the 100 seater aircraft Fokker 100 will begin to study the behaviour of the boundary layer using a laminar profile glove on the right wing and advanced sensor techniques. The project also includes theoretical work to develop methods of predicting the behaviour of the boundary layer.

**Aeroengines With Reduced Pollutant Emission:** New generation aircraft engines are more powerful and effective, but they have a tendency to emit pollutants such as nitrogen oxides in increasingly significant quantities. Reducing these emissions is a major challenge facing aeronautics manufacturers. In order to do this they need to understand precisely the mechanisms of combustion inside the engines, and the formation of aerosols. What largely determines the level of emissions is the quality of the fuel-air mixture in the combustion chamber. Six European aeroengine companies, four research institutes, and four universities are collaborating in the Low Emission Combustor Technology project. Therefore investigations into the fundamental process of pollution formation are under way covering fuel atomization, fuel/air mixing, supported by CFD [computational fluid dynamics] modelling (see below) and application of advanced diagnostic instrumentation, such as laser diagnostics. The objective of the project is the selection of the most promising emission reduction methods in compliance with efficiency, reliability, safety, and design aspects.

**Active Noise Control in Aircraft:** The control of aircraft interior noise is important for aircraft users. In the ASANCA project 22 partners work on active noise control, involving the attenuation of interior cabin noise by the generation of out-of-phase sound waves to cancel the original noise. This work has promising potential for solving the critical low frequency interior noise problems of both fixed and rotary wing aircraft. A project is under way to develop active noise control systems. Tests are being conducted in four different European aircraft covering a capacity range of 19 to 100 passengers. The technologies developed in ASANCA promise excellent spin off and are therefore also of interest to other industrial sectors.

#### The Follow-on Phase

The planned follow-on phase of the specific R&D activities in aeronautics will assure the necessary continuity which was also requested by the European Parliament. On 6 May 1991 the Council of Research Ministers agreed on the common position of the Industrial and Materials Technology programme, whose Area 3 is dedicated to Aeronautics Research with a total budget of ECU53 million.

The objectives of this activity are to strengthen the technology base of the European aeronautical industry, to contribute to the knowledge which supports actions to minimize environmental impact, to enhance the safety and efficiency of aircraft operations, and to promote

further co-operation between large high-technology companies, smaller companies, and research institutions/universities throughout the Community.

Research activities will be pursued in the following fields:

- Environment Related Technologies, especially reduction of exterior and interior noise, and the reduction of exhaust emissions from aircraft;
- Technologies of Aircraft Operation, especially maintenance technologies, health and usage monitoring, crashworthiness, fire risk control and cockpit interfaces to the air traffic control system;
- Aerodynamics and Aerothermodynamics, especially computational fluid dynamics (CFD), techniques of drag reduction by laminar flow control, propulsion integration and the internal aerothermodynamics of turbomachinery;
- Aeronautical Structures, Materials and Manufacturing Technologies, especially structural and materials techniques relevant to design concepts for pressurised fuselage structures of composite and/or metal laminate;
- Avionic System Technologies, especially techniques for design, integration and evaluation of high integrity avionic systems, particular techniques for sensing, monitoring and control of air vehicle systems, problems of man-machine interaction and flight-deck performance optimization;
- Mechanical, Utility and Actuation Technologies, especially particular techniques for optimization and the exploitation of new technologies in aircraft mechanical systems, aircraft utility systems and in aircraft actuation sub-systems.

In implementing this work, emphasis will be put on cross-fertilization and transfer of technology, especially for Member States not already having large aeronautical industries. A detailed workplan will be issued together with the Call for Proposals, which is expected for September 1991 after the Council's final decision.

#### The Longer Term Future

The requirements for research in the aeronautics industry continue to increase, reflecting the need to ensure future industrial competitiveness. Therefore European cooperative efforts will also be needed in the future.

The Commission Services are already looking beyond the time of the Third Framework Programme. In this context, a panel of senior individuals embracing a wide spread of experience in diverse disciplines relevant to aeronautics was set up to discuss and report upon the medium and long term outlook for aeronautics. This panel was asked to undertake a study on possible future actions in the field of aeronautics with particular

emphasis on matters of relevance to research and technology acquisition. The panel has recently published their findings. A report (\*\*\*\*) will help to plan future Community activities in Aeronautics.

All documents mentioned in this article and further information on Community aeronautical R&D initiatives can be obtained from the Commission of the European Communities (DGXII-H-Aeronautics) 75 Rue Montoyer, B-1049 Brussels, phone 32/2/235.08.07, fax: 32/2/236.42.88).

(\*) Document SEC(91)311 final

(\*\*) Research Evaluation Report No 46 EUR 13524 EN

(\*\*\*) Aeronautics Days 1991, Brussels, Conference Proceedings

(\*\*\*\*) "Flying Ahead", a View of the Future for Civil Aeronautics The LOTOS Panel Report, Jan 1991

### France Pushing for Increased Cooperation With Europeans, Soviets in Space Program

#### Minister Claims Public Support

92WS0034A Paris LE FIGARO in French  
27 Sep 91 p 12

[Article and interview with Paul Quiles, space minister, by Jean-Paul Croize; first paragraph is LE FIGARO introduction]

[Text] With great Community decisions being made, the government plans to rely on favorable public opinion to overcome the hesitations of its Old World partners.

Ariane launches no longer make front-page news: witness the European rocket's 46th flight, to place the Canadian Anik E1 telecommunications satellite into orbit, scheduled to take place last night (see yesterday's editions). Yet the fact that these space activities have become mundane doesn't quell the French passion for the conquest of space, or the French desire to finally see Europe join the ranks of the two superpowers by acquiring the means to send its spacemen into flight using European technology. Proof of this is provided by the results of a poll, presented here exclusively by LE FIGARO. It was ordered by Paul Quiles, the minister of equipment, housing, transport and space, to discover how the nation feels about the large European space projects.

Conducted by IREC on a sampling of 1,137 persons representative of the French population, the study shows that, far from being weary of them, 83.5 percent of us are in favor of the manned flight programs proposed by the European Space Agency. Since the poll was preceded by an explanation of the nature of the programs, which will enable European spacemen to fly with their own wings, the response constitutes a massive approval of the Hermes shuttle and Columbus space station. Both of them should become realities at the end of the century.

This is a particularly encouraging bit of news for engineers and political decisionmakers alike. Both are waiting for the fate of the two projects—whose funding will require an investment of nearly 100 billion French francs [Fr]—to be settled next November during a summit meeting of the European space ministers in Munich, Germany. It is especially encouraging as 74.5 percent of the French think it is important to begin carrying out the two projects immediately, and over 60 percent even give their approval "without financial reservations."

In answering our questions, Paul Quiles explained how this solid backing by public opinion should "spur" the French position in Munich, in the face of German and Italian hesitation. Indeed, the IREC poll shows clearly the firmness that we expect of our decisionmakers: 75 percent of us still consider France to be the Old World's leader in space conquest. And we think it is France that will have to convince the ministers in Munich that sending spacemen into flight is a great European project, as 86 percent of us believe, and will bring positive spinoffs for the entire continent's industry, as 83.5 percent of those polled thought.

#### "For Technological Independence"

LE FIGARO: Are the results of this poll the sort of thing that could influence the fate of Hermes and Columbus?

Quiles: Naturally, decisions of this importance will not be made solely on the basis of polls. Nonetheless, they are useful indications. As France's representative in Munich, I will defend an ambitious course for Europe's space program, and it is important that I be able to count on a public opinion that is extremely favorable and willing.

Allow me, moreover, to make a general comment on the poll. In my opinion the French express an enthusiasm, an optimism, a certainty of success that delights me. Personally, I like this adventurous France, open to the world and free of complexes. It is the kind of France that is successful, and that succeeds by joining forces with others. Space provides us with an excellent demonstration of Europe's capacity to be, combined, what we can no longer be alone.

This is particularly true of the European Hermes spaceplane and Columbus orbital-station programs, which we would could not carry out alone.

LE FIGARO: Will France's stake in these big programs, which is currently a majority one, remain stable or decrease as part of an effort to adjust the balance?

Quiles: There will certainly eventually be a readjustment when the time comes to define the future big programs. Once our partners have acquired new skills, they will obviously want to increase their share. For now, the big programs (Ariane 5, Columbus, Hermes) take us past the year 2000. Participation by the states will remain stable until then. France initiated the European space program,

and for that reason its share is high: 45 percent of the Ariane 5 program, 43.5 percent of Hermes, and 13.8 percent of Columbus. We thus have a predominant share, but there is no question that the goal is to construct an extremely dynamic technological Europe that performs well internationally.

The French have understood very well that space is an area that enables us to be competitive with Japan and the United States in electronics: It is thus a means of developing our technological independence. Power today no longer rests in coal or steel, but in microcomponents, software, and computing power... To reconquer our autonomy and power we must master space technology.

### Peaceful Power

**LE FIGARO:** The French say they are ready to accept a purely French conquest of space if our partners defect. Does that strike you as possible?

**Quiles:** It is not realistic, since the Ariane 5 program alone represents over Fr31 billion, and Hermes, Fr48 billion. Moreover, there are no indications that our partners would defect. On the contrary, my many contacts with my European counterparts to prepare the Munich conference shows me that, despite the great cost of the program, Europe's determination is strong. That said, the reaction of the French shows that they have gauged the stakes. They want a commitment to send a European into space without delay, for they have understood that it is a peaceful and effective way of affirming Europe's technical and scientific power.

**LE FIGARO:** It seems that many French have not yet fully realized that the space programs have become "Europeanized." How can this deficiency be corrected?

**Quiles:** I think that this inaccurate assessment of the European reality of the space programs is due to the preponderant role that France has played in getting the European space program off the ground, and to the ambition our country continues to display in that area. The European character of the space program will eventually sink in, notably through carrying out the Hermes and Columbus programs. When the event all of Europe is waiting for—that is, a European in space using European technology—happens, this idea will long have been corrected.

Ultimately, the space program will no longer be solely European, but international. I am thinking in particular of the voyages to Mars and the big programs to understand and protect the earth's environment. That is why I not only maintain close contacts with European counterparts, but also with international officials. Last May, I met the vice-president of the United States, Dan Quayle, who presides the National Space Council. I have traveled to the USSR several times, and plan to return there soon to discuss new joint projects. I am convinced that the increasingly universal character of the conquest and use

of space will lead to new forms of cooperation within the world community. I will have the opportunity to make proposals along those lines.

### CNES Pursues Joint Missions

92WS0034B Paris *LE MONDE* in French  
1 Oct 91 p 32

[Article by Tours special correspondent Jean-Francois Augereau: "French-Soviet Space Cooperation Continues"; first paragraph is *LE MONDE* introduction]

[Text] The upheavals that have just rocked the Soviet Union made many believe that most of the cooperative projects launched before the putsch were threatened. Officials of the National Center for Space Studies (CNES) were thus awaiting the Franco-Soviet Space Encounters, which were held from 25 to 27 September in Tours, with some trepidation. Apparently their worry did not prove justified.

One of the fears was that the Antares mission, which is scheduled to send a French cosmonaut to the Mir station for a 12-day stay in July of 1992, would be delayed. Another was that the ambitious program to explore the red planet using Franco-Soviet probes, "Mars 94", might be axed, felled by budgetary cuts and the current absence of decisionmaking power in the Soviet Union.

Although the representatives of the Soviet delegation in Tours had no idea what tomorrow might bring, this did not keep them from displaying an "astonishing dynamism and determination to go forward", according to those who spoke with them. Yet it is clear that they are wondering about the future of Glavkosmos, the agency in charge of promoting Soviet space programs, and of Iki, the organization behind all the big scientific space missions, and whose future seems more promising. They are also wondering about the role and nature of the next government organization that will be responsible for Soviet space programs.

Will the government create a sort of space agency integrating the different existing organizations, or with which they will work, as in the West? One has only to listen to the academician Alexandrovitch Kotelnikov, who is the president of the Interkosmos Council of the USSR Academy of Sciences. "For next year," he says, with a malicious gleam in his eye, "I don't know. His comment reveals all that is at stake in the drama that is now being played out. Its different strands include the future of the existing organizations, the fate of some of their directors—whose role during the putsch is being scrutinized—and the struggle for power between the Republics and the central authorities.

### Coming to Terms With the Republics

In this regard the statements of the hot-headed president of the Russian Federation, Boris Yeltsine, has more than one of them trembling in his boots. Mr. Yeltsine is not at all averse to raiding the space budget to solve a few

particularly urgent economic problems. Likewise, the current officials of the Soviet space program know that they will have to come to terms with other Republics. The Ukraine shares a portion of the country's aerospace installations and industries with Russia; Kazakhstan, where the Baikonour launch base is located, has just declared jurisdiction over all the installations within its territory. And as Mr. Evgueni Bogomolov, a member of the Glavkosmos administration, pointed out in Tours, "The Kazakhs' position could serve as an example for other Republics."

In this imbroglio, every gesture counts. One such is the upcoming flight of a Kazakh cosmonaut to the orbital station Mir, and a simultaneous one by an Austrian. The first is motivated by internal politics and the second by reasons that are even more strategic. In the midst of the storm that is shaking the country, it is advisable for the Soviet Union to show that it is still a good partner for the foreign countries anxious to pursue a space program, and that it keeps its promises to third parties.

#### A Major Partner

This good faith is recognized by the CNES. Its assistant general director, Mr. Daniel Sacotte, hopes that "the space cooperation with the Soviet Union will continue." During the Tours Encounters, the French and Soviets already brought up the next Franco-Soviet manned flight scheduled for 1995-1996, and discussed possible ventures in space telecommunications.

Moreover, the door to Europe is not closed, judging from the tenor of the message sent to Mr. Kotelnikov by Mr. Paul Quiles, the minister of equipment, housing, transport, and space. "France," he wrote, "thinks that the European space industry that we are building should be open to the world. Your country is a major space partner for France; it could become one for Europe." In other words, France and Europe must be given the time to set up a coherent space program, at the interministerial conference that will be held in November in Munich, before the door to greater cooperation with the USSR can be opened.

In the meantime, all that remains is to prepare the pioneering Soviet cooperation programs. They include the manned flight Antares, which is costing the French some 12 million dollars, and the "Mars 94" mission. Though not threatened, the latter has now been split into two subunits. One will place into orbit in 1994 an observation ship carrying probes and penetrators to study the planet's soil; the other will launch a second vessel in 1996 that will carry balloons to be jettisoned in the Martian atmosphere and a small automated exploratory vehicle similar to the famous Lunokhod.

#### Fifth German Space Program Outlined

92WS0001C Bonn LUFT- UND RAUMFAHRT  
in German Jul-Aug 91 p 9

[Article: "Outlines of the German Space Program"]

[Text] Work has been in progress for a long time on the Fifth German Space Program, but a public announcement

is not anticipated until fall of 1991. However, a few outlines and major points are already becoming clear. The following are presented as strategic goals:

- To increase scientific knowledge about space, the solar system, the earth, and the conditions for life on earth,
- To contribute to the solution of environmental problems through satellite-assisted observation of the earth's land masses, oceans, ice, and atmosphere and to support climate research,
- To improve public and commercial infrastructures and services via space-based telecommunications, location, and navigation,
- To stimulate technological progress and thus to contribute to the increased efficiency of the German economy,
- To make access to space and its use safer and more economical,
- To foster international cooperation primarily in science and technology and to expand the potentials for developmental assistance,
- To perform verifications of arms control tasks, crisis management, and perhaps even environmental monitoring jointly with European partners.

The actual projects are to be implemented in three phases moving from adaptation to new themes (infrastructural use and exploitation as a focus, with new goals and tasks, and later "visionary prospects" in the direction of the reclamation of resources from space, moon/Mars missions, etc. will be examined).

Through 1998, the program is characterized by the rubric "continuity and adaptation" ("building on successes, reliable partnerships, continuation with adaptation of the large projects"). The following period through 2010 is characterized by the rubric "flexibility"; adjustability is to be created and new focuses set. After that, new tasks will be planned which are currently referred to by the key words of space travel as service, applicational orientation, and new structures.

In the last few months, there have been strong disagreements about the issue of how much the financial requirement of approximately 30 billion German marks based on current planning must be cut. A decisive factor will be whether the emerging cuts and extensions in the ESA's [European Space Agency] large projects will be too much at the expense of domestic programs (including the DLR's [German Aerospace Research Institute] basic financing).

#### DLR, Soviets Cooperate in Space Medicine

92WS0001B Bonn LUFT- UND RAUMFAHRT  
in German Jul-Aug 91 p 7

[Article: "DLR: Cooperation With Moscow Institute"]

[Text] Within the framework of the cooperation between the Institute for Biomedical Problems in Moscow and

the DLR [German Aerospace Research Institute] for Space Medicine, the so-called "Medex apparatus" has been introduced into the USSR. Medex refers to a whole group of medical devices with which it is possible to investigate human heart and circulatory functions under conditions similar to those in space.

Soviet and German researchers are using differing simulation methods for the investigations. German scientists prefer a method in which the subjects assume a slight head-down position. This causes body fluids to shift to the upper half of the body. A similar phenomenon occurs in space in the absence of gravity. Soviet scientists have relatively long experience with so-called "water immersion." For this, the person lies in water virtually completely sheathed in a film. In this manner, the hydrostatic pressure components are varied, but the test subject remains dry. Because this creates a state comparable to weightlessness, this method is also suitable as a simulation.

Agreement has been reached on a common procedure for the coming SLS missions on the American side and for the German D-2 mission and for the German-Soviet MIR mission. A mutual exchange of scientists is planned. Whereas the DLR scientists can investigate their questions using water immersion, on the other hand, the Soviet scientists will introduce their questions into head-down position studies.

**Italy: Studies on Mach-3 Airliner for Year 2000**  
92WS0032A Rome L'ESPRESSO in Italian 6 Oct 91  
pp 169-171

[Article by Eugenio Celati: "If the Price Is Right We Are All Concorde" [a play on Italian word for 'in agreement']; first paragraph is L'ESPRESSO introduction]

[Text] Flying in the year 2000. Birth of the new supersonic plane: 300 passengers at 3,000 kilometers per hour, paying tourist class fares.

As the Concorde, the first and only civil supersonic jet, with its dozen or so surviving models, celebrates its 22 years of troubled life, the world's seven major aeronautics industries (including Italy's Alenia, the Japanese, and the USSR's Topolev) have combined their outlays on studies of the year 2000's supersonic jumbo, designated the HSCT, an English acronym standing for High Speed Civil Transport: A plane that will carry between 200 and 300 passengers at a speed of over 3,000 kilometers per hour, almost 3 times the speed of sound, covering the distance between Europe and North America in 3 hours, as compared to the present 8, or the distance between Tokyo and Los Angeles in 4 and 1/2 hours, as compared to the present 12.

With the passing of the 1970s' oil crisis, and of the 1980s' travel boom establishing air transport as a form of mass transportation, and international charter flights at slashed fares, the privilege of flying faster and higher than anyone else, seemingly a thing of the past, is back

making itself felt again, with people who are willing to pay. "Of the passengers flying the North Atlantic routes, 23 percent travel at full fare [1st class]," according to some at Aerospatiale, the French company that built the Concorde jointly with the British, and that is now working on the HSCT project. "The aim is to get this 23 percent to fly in the new supersonic plane at a base-fare that should not exceed the tourist class fare by more than 50 percent." Laudable intentions, considering that, today, to be one of the mere 100 passengers on a Concorde Paris-New York flight, one must pay the equivalent of 5.2 million lire more than the 1st class fare on a jumbo jet.

On the other hand, the idea of going from Paris to Washington for a meeting and returning that same evening is rather tempting. Also tempting is the idea of being able to get to Singapore in 4 hours and to Australia in half a day. Today, according to Air France, passengers on business trips fill two thirds of the Concorde's seats. But tomorrow, with reduced fares, improved performance, and a foreseeable increase in international traffic, will the demand be sufficient to justify the production of 300-500 planes, the number that will be needed to ensure the required economic returns on an undertaking that will cost \$10 billion?

The industries' answer is a positive one, provided the HSCT project has no competitors. According to Rolls-Royce, which built the Concorde's engines and is now studying jointly with the French the new supersonic plane's engines, "Each company will be able to buy only a few of them. So, the presence of several models on the market will benefit no one." For this reason, the seven industries will continue their joint studies until next year, with a view to reaching a "global agreement" on the production of a single model of supersonic plane, to be built jointly by companies that in today's market are stabbing each other in the back.

The road to carrying passengers at an altitude of 18,000-20,000 meters is not an easy one. The major difficulty lies in the environmental problems it raises. The supersonic plane flies close to the ozone layer, which by now resembles a moth-eaten blanket. What will happen when the routes of 300 airplanes crisscross what is now a little-traveled zone? To gain some insight into this question, the French with the Concorde, and the Soviets with their homologous Tupolev 144 (Eastern Europe's supersonic plane, renamed the Concordeff and immediately taken out of service following a series of accidents), plan to carry out a number of experiments over the next few years, to evaluate the potential destruction of part of the ozone layer by engine exhaust gases.

Another unknown factor: The noise created by the acceleration of the plane's four engines at low altitude. With the Concorde's economic failure tied mainly to the initial refusal to allow the supersonic plane to land in the

United States for reasons of noise pollution, the European engine makers are rather sensitive on this subject. Around the end of the 1970's, in the wake of the blocking of North American routes, a total of 150 firm orders and options were canceled (including those of Alitalia and Lufthansa). Two years later, as the Concorde production line came to a halt, the American ban vanished. Many assert that the role played in this matter by the lobbies of the U. S. aeronautics industry, displaced from its corner of the European supersonic market, had not been a minor one.

Today, a "global agreement" on the HSCT plane would no longer pose a problem of lobbies. But the engine makers are certain to have to reckon with the environmentalists. Aerospatiale engineers foresee that "the supersonic plane project will undoubtedly have to obey the most stringent of rules on noise pollution"—the same ones that, in the United States, are now outlawing many DC-9's and Boeing 727's.

Meanwhile, the HSCT plane has already taken shape on the designers' drawing boards. It will have a fuselage as wide as that of the DC-9, delta wings with a vaguely Gothic shape, a frame of titanium and composite materials, to enable it to withstand temperatures in excess of 200 degrees Celsius owing to atmospheric friction, and very small portholes. Jean-Jacques Huber, Aerospatiale's head designer, maintains that "The ideal would be to completely eliminate the portholes, since they reduce the strength of the fuselage structure. They could be replaced by television screens."

The big seven have agreed to meet at the end of 1992 to decide whether or not to launch the HSCT undertaking. But meanwhile, someone has already moved. The U.S.-based Gulfstream company, sensing the freeing of the USSR's economy, has formed an alliance with the Soviet firm Sukhoi, maker of the top Soviet fighter planes, to build a 16-seat supersonic executive plane. Plans call for a first flight in 1994 and deliveries starting in 1997. The price: \$40 million. Estimated sales: 20 aircraft to top Soviet industries, around 40 in the United States, and as many again in Europe and Japan.

#### **Dutch Company To Supply Ariane-5 Igniters**

91AN0549 Rijswijk POLYTECHNISCH WEEKBLAD  
in Dutch 22 Aug 91 p 3

[Article by Gerard van Nifterik: "Stork Igniters Will Get Ariane-5 Rocket Going"]

[Text] Stork Product Engineering (SPE), together with Aerospace Propulsion Products (APP), is to supply 600 igniters for future European Ariane-5 rockets. This is a follow-up order which concerns the turbopump starter, i.e., the actual rocket booster. The contract—which continues through 1995—is worth approximately 25 million Dutch guilders. Moreover, Stork is still in the running for a follow-up order for igniters which are to be used in the main combustion chamber and gas generator.

The recent orders for SPE are a direct result of earlier research and development that Stork carried out for the French rocket engine manufacturer European Propulsion Company (SEP). On behalf of the French National Center for Space Research (CNES) and the ESA [European Space Agency], SEP is the prime contractor and leader of a project for the development of the HM-60 Vulcain engine. As of 1995, the Vulcain will power the new European Ariane-5 rockets.

The Stork igniters are modeled after similar devices on the much smaller Ariane-4 engine. In total, there are three different igniters which activate various engine functions consecutively.

#### **Starter**

The HM-60 Vulcain is a cryogenic engine which is powered by the combustion of a hydrogen-oxygen mixture. Turbopumps ensure that both fuels are fed to the combustion chamber at the right pressure (5 to 30 bars). If this is not the case, the rocket engine will fail to provide sufficient thrust. The turbopumps themselves are driven by a gas generator which also operates in a hydrogen-oxygen mixture. Since the initial power supply of the gas generators is not sufficient to activate the turbopumps to full rotational speed, an additional facility is provided: the turbopump starter (TPS). This starter produces a short pulse of approximately 1.5 seconds which immediately enables the turbopump to produce sufficient pressure. The combustion chamber and the gas generator are fitted with igniters which, along with the TPS, are manufactured by Stork in Amsterdam.

In the meantime, full-scale prototypes of the HM-60 Vulcain engine are being tested at two locations in Europe (Germany and France). The SEP is conducting these tests to see whether the engine is actually operational and, above all, to test its original specifications. The 600 turbopump starters to be manufactured by SPE will be used primarily for this testing and evaluation program.

#### **Tests**

According to Eng. Arthur van Bakkum, a member of SPE's igniter project team, these tests have already led to some changes in the technical specifications. For example, the TPS is to be manufactured using materials other than those initially planned. Other modifications are likely to follow. For instance, the strict requirements which were originally set with regard to the ignition temperature turn out to be hardly feasible (the temperature affects the TPS' mass flow) and some minor problems regarding the construction and in mounting of the igniters will also have to be dealt with. The Vulcain test program runs until 1994.

#### **[Box]**

##### **Three, Two, One...**

The ignition of a Vulcain engine occurs as follows. First, the igniter in the combustion chamber is activated to

avoid hazardous buildups of hydrogen/oxygen. Then the gas generator igniter is activated. (The gas generator utilizes the same fuel mixture as the main engine.) The resulting expansion drives the turbopumps which control the pressure level of the fuel supply.

A third igniter is used to boost the turbopumps to the required rotational speed. This device is logically called the turbopump starter (TPS). In less than two seconds, the TPS brings the pumps to full rotational speed, after which the gas generator takes over.

The TPS differs from the two other igniters as regards size and mass flow (2 kilograms per second for the TPS versus 60 grams for the other two). These differences are function-related: The igniters of the combustion chamber and the gas generator only have to initiate the combustion process of the hydrogen/oxygen mixture, whereas the TPS has to produce thrust on its own.

Despite their different functions, the basic design of the three igniters is similar. All three have a metal housing which contains a plastic cartridge holding the solid fuel and an electrical ignition device that is only a few centimeters large.

The TPS is a more than 30 centimeter long metal cylinder with one cone-shaped tip. It is still being manufactured in stainless steel (later versions will use a nickel alloy) and is completely filled with solid fuel. The fuel (mainly ammonium nitrate and a binding agent) has been developed by the Dutch firm Aerospace Propulsion Products. The ammonium nitrate mixture is contained in a plastic cartridge (currently still a technical plastic, to be replaced by a synthetic rubber). On the inside of the cartridge's walls, there are lengthwise fins (blades) a few centimeters high. This construction allows a phased combustion to take place, which is needed to ensure an optimal start of the turbopumps: an initial boost phase causing a peak output of particles, followed three-quarters of a second later by a sustain phase with a slightly lower mass flow.

The flat end of the TPS is fitted with a cartridge that activates the ammonium-nitrate contents. This ignition system—based on a mixture of magnesium and teflon—is initiated electrically. According to C.R.H. Bredt, project manager for Stork's igniter project, delayed ignition of the ammonium-nitrate mixture is a critical aspect of the engine as ammonium-nitrate is difficult to ignite. The choice of this fuel would seem rather strange if it was not for the fact that ammonium-nitrate is one of the few fuels that do not cause chlorine pollution. Chlorine in the propellant would cause detrimental erosion of the engine.

## AUTOMOTIVE INDUSTRY

### France: Peugeot Presents Environmental Plan

92WS0003A Paris AFP SCIENCES in French  
12 Sep 91, p 63

[Article: "Peugeot S.A. Group's Environmental Plan"]

[Text] Paris—In Paris on 5 September, the Peugeot S.A. automobile group presented an environmental plan

"responding to the government's desire to see the industrial enterprises match the National Environmental Plan presented by Mr. Brice Lalonde last October."

The plan is based, according to the automobile manufacturer, "on the principle of preventing pollution at the source," and addresses, first of all, the action programs at the manufacturing sites, especially from the standpoint of reducing the waste products in the atmosphere by limiting specific emissions in iron and steel foundries, using alternative fuels to reduce the sulfur dioxide content of emissions in thermal plants, and reducing the emission of solvents issuing from paint shops. The plan also provides for the regulation of water consumption, biological treatment of waste water, and the monitoring of liquid wastes.

The plan includes six programs of action on products, aimed at achieving a "clean car," primarily by reducing exhaust system emissions through the optimization of present-day techniques such as the catalytic converter, through research on less-traditional techniques such as two-cycle engines, hydrogen and new fuels. Other objectives include: A "temperate" car, through a reduction of fuel consumption under a 2.5-billion-franc program; and a "silent" car, through a reduction of power-unit noise.

Peugeot also presented a prototype of the Peugeot 405, a heavy-duty station wagon powered by an electric generator set that provides a greater cruising radius than does the use of batteries (100 km). The Peugeot group further indicated that it intends to propose to the Brussels Commission a new approach to the anti-pollution regulatory process, based on adherence by every manufacturer to a norm to be set, not model by model as at present, but in terms of a mean for the vehicles sold on the European market.

### Germany: Progress Slow in Aluminum Battery Development

91WS0504A Duesseldorf VDI NACHRICHTEN  
in German 2 Aug 91 p 18

[Article by Rudolf Weber: "The Road to an Aluminum Battery Is Rocky;" first paragraph is VDI NACHRICHTEN introduction]

[Text] Basel, 2 Aug 91 (VDI-N)—The aluminum battery is a focal point for worldwide research on better energy storage. In this connection, the aluminum-air battery, which can even be operated with ordinary sea water, seems especially attractive. However, models for sale today have relatively little power. In order to meet the significantly greater demands of electric cars, for example, a great deal of research work still needs to be done.

Aluminum possesses a property which is extremely welcome for many of its applications, but which is an obstacle to its use as electrode material in batteries: In



air, weak acids and lyes (which is what most electrolytes are), it forms a thin and hard layer of aluminum oxide. On the one hand this layer largely protects the metal from corrosion, but on the other as an electric insulator it inhibits the passage of ions or current, respectively. The basic problem with all aluminum batteries is therefore to circumvent the insulating effect of the oxide film.

When using aluminum in primary batteries there are several possibilities for the selection of electrolyte and counter-electrode. Most attractive is certainly the aluminum/air battery. Several models of this with about 1 V cell voltage and with a high energy density came on the market as early as the late 1980's. But due to their lower power density they are only suitable for a few special applications; one can only withdraw a few watts of power per kilo of battery weight, while a few dozen kilowatts are needed to power electric vehicles.

In these batteries aluminum rods or plates form the metal electrode. A pipe of a porous material such as graphite sponge, which permits the access of oxygen, serves as a counter-electrode. Suitable for use as electrolytes are, among others, solutions of table salt in water or simply sea water. In this solution aluminum ions form at the aluminum electrode and hydroxyl ions at the oxygen electrode, and they combine with each other in the electrolyte into aluminum hydroxide. From the latter it is in principle possible to reclaim the aluminum and use it again as an electrode. In practice, however, precipitation of the hydroxide is so difficult that researchers regard this as one of their principal tasks of further development. Another task is to prevent the formation of hydrogen and detonating gas (a hydrogen-oxygen mixture) when using aqueous electrolytes.

But of decisive importance in order to achieve high performance densities will be how successfully the oxide skin can be overcome. Theoretical discussions have not gotten very far yet, so that one must primarily rely on practical experiments. And in so doing it has turned out that aluminum alloyed with metals such as gallium, indium, magnesium, or manganese lead to better values. The explanation: Wherever atoms of these metals come to rest on the surface of the aluminum electrode, they form tiny "active" surfaces, only thousandths of a square millimeter large; apparently no oxide skin forms above them, so that the electrochemical oxidation preferentially takes place at these places.

In Switzerland a Group For Electrochemistry at the Paul Scherrer Institute (PSI) in Villigen has been working since the mid-1980's on both primary and secondary aluminum batteries (the work was supported by the energy industry's National Energy Research Fund, NEFF). In the field of primary batteries, PSI researchers initially succeeded in raising the performance density of aluminum/air batteries by more than 50 percent by adding indium and zinc to the table salt electrolyte. However, even better results are qualified by the fact that the aluminum which has become dissolved in the electrolyte cannot again be separated out from aqueous

electrolytes, which is necessary for recycling. No separation is possible from nonaqueous solutions. Various salts are under consideration for this, but in each case serious disadvantages have to be taken into the bargain for the desired benefit. For example, the electric conductivity of solutions containing organic or inorganic salts, such as are used in lithium batteries, is very much lower than in aqueous electrolytes.

Molten inorganic salts, which could be suitable as electrolytes for rechargeable aluminum-chlorine batteries, have significantly higher conductivity. The melting temperatures of 350 to 500 degrees C not only require that the battery be heated up, but also result in material and corrosion problems. In order to avoid those, the group around Dr. Otto Haas is now starting experiments with organic salts, which are fluid even at room temperature and from which aluminum can be separated out and—in reverse—again dissolved. Organic polymers such as polyaniline are used as counter-electrodes. Based on initial measurements, it is expected in Villigen that such a rechargeable aluminum/polyaniline battery will have a cell voltage of 1.8 V—and that there is much more work ahead, primarily in order to reduce the weight of the counter-electrode and the electrolyte.

The road to aluminum batteries is also rocky—one step forward, half a step backward. Nevertheless, the progress made in the last few years makes it possible for the researchers' hopes for practicable aluminum batteries, far superior to the lead storage battery, not to seem unrealistic. Energy densities of up to 300 Wh/kg battery weight have been reached in primary batteries, about 10 times that of lead storage batteries (with the same weight an aluminum battery can thus store 10 times as much energy). And with respect to the energy yield, one has now arrived at 50 percent, that is to say half of the energy stored in an aluminum electrode can be released. This is already attractive as an emergency power supply. If it were possible also to obtain similar values and, above all, to get significant performance density from secondary aluminum batteries and accumulators, respectively, this could create a strong, perhaps even decisive, impetus for the development of electric vehicles.

#### **Electric Cars Presented at Frankfurt Show**

*92WS0003B Paris AFP SCIENCES in French  
12 Sep 91 pp 63,64*

[Article: "The Electric Car: Fad or Solution of the Future?"]

[Text] Frankfurt—Today, all the automobile manufacturers know how to build an electric car, and the 54th Frankfurt Automobile Show, which opened on 12 September, is overrun with prototypes in this domain.

Figuring prominently among the recent "all-electric" creations at the Frankfurt show—in addition to a small BMW, baptized the E-1—is Renault's latest, the Elektro-Clio, built jointly with Germany's Siemens firm. It is revolutionary in more than one respect, in that, today, it



is powered by synchronous three-phase alternating current, and not by direct current as was its 1990 predecessor. Its motor has the power of a 1,000 cm<sup>3</sup> thermal battery, and enables the attainment of speeds of up to 120 km/hr.

According to Renault, "the Elektro-Clio has a range of 80 km in the city without refueling, enabling it to cover approximately 70 percent of daily travel requirements." But—and the drawback is one of scale—this range is attained only at a speed of 50 km/hr, and melts like snow under a hot sun as this speed is exceeded. Considering present-day driving habits, this range, even within city limits, is still insufficient.

Were this car to be commercialized, its sale price, today, would be approximately twice that of a thermal-powered Clio of equal power, assuming the use of simple lead storage batteries. Approximately 45,000 francs would have to be added for cadmium/nickel batteries. Furthermore, in both cases, these batteries would require charging times of around six hours.

A false problem, one might think, inasmuch as Nissan is expected to present new batteries at the Tokyo Show next month that can be charged in 6 short minutes. But what the Japanese manufacturer is not revealing for the moment is that the current required to recharge them must be supplied at a potential of 800 volts. This level of power could perhaps be installed in service stations, but for the time being the installation costs would be prohibitive.

Then there is the hybrid vehicle, equipped today with a diesel motor-generator set that produces its own electricity, and tomorrow with a turbine, undoubtedly a gas turbine, that will drive a high-speed electric power generator. During highway travel, this generator will charge a battery that can then be used alone for city-driving. Volkswagen with its Chico, and Peugeot with its 405, are presenting prototypes at Frankfurt.

The Peugeot 405 has, as of now, a top speed of 121 km/hr and a highway cruising radius of 750 km, starting with a full tank of diesel fuel. But in town, this range is sharply curtailed, inasmuch as this vehicle is heavier than a small all-electric vehicle. Moreover, no one, or hardly anyone, will operate it in the "all-electric" mode, unless some cities go so far as to bar their municipal centers to thermal-powered cars—not a likely step in the immediate future.

Despite all these handicaps, the all-electric vehicle seems sentenced to bear the brunt of a (false?) solution to tomorrow's problems. The state of California has already decided that "zero-pollution vehicles" must represent, for every manufacturer, and by 1995, 2 percent of their total registrations in that state. This percentage is expected to rise to around 10 percent within 20 years. And several other American states appear to be preparing to enact similar restrictions.

## BIOTECHNOLOGY

### France: Report on Status of Genetic Engineering Research Published

91WS0540A Paris LE MONDE in French  
1-2 Sep 91 p 9

[Article signed J.-P. D.: "A Science Academy Report: France Must Consolidate its Position in Protein Engineering"]

[Text] Creating specific advanced studies diplomas (DEA), setting up efficient databases, such are the main recommendations of the Science Academy's report on "protein engineering," which was made public Wednesday 28 August. This is a research field with considerable industrial stakes in sectors as varied as pharmaceuticals and agriculture.

From enzymes to hormones and antibodies, proteins are the building blocks of living cells. The term "protein engineering" covers most of the research aimed at modeling them—in most cases by working on genes—in order to obtain new products (vaccines and drugs, pesticides, industrial enzymes, etc.). This shows the industrial importance of the field, "one of the most promising scientific projects," according to the latest report of the Applications Committee of the Science Academy (CADAS), entitled "Protein engineering; France's place in international competition," which was written by a group of 16 scientists and manufacturers headed by Mr. Henri Heslot (tenured professor of molecular and cellular genetics at the National Agronomic Institute).

Faced with the desire of the companies and organizations involved to protect the confidentiality of their research, the authors of the report—the Science Academy indicated—had to devote "nearly two years of relentless work" to the preparation of this inventory. The evaluation criterion chosen, i.e. the analysis of 306 patent applications filed throughout the world in the past three years, shows that France (23 patent applications) has achieved "an honorable rank." It lags far behind the United States, the unchallenged leaders with 155 patent applications, but is ahead of Japan (18 patent applications), Great-Britain and Germany. Among the French champions, the Transgene company (8 patent applications) and the Pasteur Institute, alone or in partnership with the CNRS [National Center for Scientific Research] and the INRA [National Agronomic Research Institute] (6 patent applications).

### Insecure Lead

However, in a field where "the volume of scientific data is multiplied by two every 15 months," this position is insecure. This impressive increase in the volume of data should further accelerate when the current attempts at sequencing certain genomes (the human genome as well as those of the most commonly used microorganisms: yeasts and *Bacillus subtilis*) succeed.

To ensure a rapid transfer of knowledge to the industry, the CADAS recommends the creation of databases "suitable for interdisciplinary use" and "designed as networks." This project, the authors of the report believe, should be sponsored by "a public-interest group including large research organizations, industrial firms, and the ministries concerned," and it should take into account the results achieved and the projects in progress in the EEC or at international level.

The CADAS is pleased with the government's initiatives to intensify research, e.g. projects like Proteins 2000 (CEA [Atomic Energy Commission]), Imabio (CNRS), the creation of the Organibio association (which enables state and industrial research organizations to work as partners on specific projects), or the creation of the new Protein Biology and Chemistry Institute in Lyon. The CADAS recommends to continue and intensify this effort; in particular, it recommends that large research organizations should launch new "theme-related programs" (ATP). A "guiding committee," consisting of representatives of government and industrial research organizations and supervised by the Ministry of Research, should "ensure the coherence" of these initiatives.

Finally, the Science Academy recommends that an effort be made to train scientists, through the creation of advanced-studies diplomas "specifically geared to protein engineering." The large research organizations should, for their part, intensify their "exchanges of teaching scientists and students with leading foreign laboratories."

#### **France: Officials Propose Legislation To Assess Risks of Genetic Engineering**

92WS0036C Paris LE MONDE in French  
3 Oct 91 p 11

[Article by Franck Nouchi: "Introduced at the Ministers Council, a Bill To Regulate the Use of Genetically-Modified Organisms"; first paragraph is LE MONDE introduction]

[Text] At the ministers council of Wednesday, 2 October, Mr. Hubert Curien, minister of research and technology, and Mr. Brice Lalonde, minister of environment, introduced a bill aimed at controlling "the use and dissemination of genetically-modified organisms." The bill would bring French legislation in compliance with the guidelines on genetic engineering adopted in April 1990 by the EEC council of environment ministers.

Two European guidelines, which ecologists had demanded for a long time, regulate the voluntary dissemination of genetically-engineered plants or microorganisms in the environment of EEC countries, under cover of a stringent preliminary administrative control (LE MONDE, 11 April 1990). Transcribed into French law, these two guidelines will substantially modify Law No. 76-663 of 19 July 1976 on "facilities classified for the protection of the environment."

By "organism," the bill introduced at the ministers council means "any acellular, cellular or multicellular biological entity capable of reproducing itself or of transferring genetic material" (this definition covers microorganisms, including viruses). As for a genetically-modified organism, it is "an organism whose genetic material was modified otherwise than by natural multiplication or recombination."

Two commissions will be set up: one, the genetic engineering commission, will evaluate the risks presented by genetically-modified organisms and the processes used to obtain them (actually, this commission already exists, but the bill strengthens its role); the other, in charge of studying "the dissemination of products obtained through biomolecular engineering," will evaluate the risks involved in the voluntary dissemination of genetically-modified organisms and contribute to the evaluation of the risks "linked to the marketing of products consisting of genetically-modified organisms or containing such organisms."

#### **Immense Hopes**

One of the main provisions of the bill is the introduction of a "confinement obligation" for all operations involving microorganisms. In addition, in the case of microorganisms, the bill will add a procedure of "preliminary administrative approval."

Other major points of the bill: first, except in the case of industrial production using pathogenic organisms (vaccine production), no preliminary public inquiries will be required, as these would considerably hinder research, especially in genetic engineering; then, as far as the composition of the genetic engineering commission is concerned, after extensive debates involving the various ministries concerned it was decided that it would remain exclusively scientific, as the Ministry of Research wished it.

The bill, which had become indispensable in view of the considerable development of genetic-engineering techniques, should as a whole reassure researchers. As they urged, it is the Ministry of Research that will deliver authorizations for research, teaching, and development operations.

This way, one may hope that France will be spared what happened in the Federal Republic of Germany—where the stringent regulations demanded by environmentalists [the "Greens"] caused manufacturers to move to other countries to continue their exploration of these very promising research avenues.

Contrary to the common belief, genetic engineering has not killed anybody until now, nor caused the least damage to the environment. On the other hand, it gives rise to immense hopes, in particular in human therapeutics. Already, insulin and the growth hormone are produced through genetic engineering.

Looking ahead, there is every reason to believe that the anti-AIDS vaccine—if it is to be found some day—will be produced through genetic engineering. And breakthroughs are expected in other fields, e.g., selective insecticides, and pollutant-removal treatments for soils or large waste accumulations.

### Genetically-Engineered Production in Animal Milk of Key Human Proteins

92WS0012A *Paris LE MONDE in French*  
18 Sep 91 p 14

[Article by Martine Laronche: "Protein Farming"; first paragraph is LE MONDE introduction]

[Text] Production of human proteins in the milk of transgenic animals could become a full-scale industry in coming years...

When will we have "molecular" farms? Will industrial production of human proteins for therapeutic purposes, from the milk of goats, sheep and even cows, become a reality in the coming years? Drug manufacturers think prospects are good enough to merit collaborating in numerous research programs.

In 1987, a team of British researchers demonstrated for the first time that a "transgenic" mouse could produce a foreign protein—ovine beta-lactoglobulin in this instance—in its milk. Since then, a dozen teams around the world have worked on various mammals with the end in view of producing human proteins. In the September issue of the British review *BIOTECHNOLOGY*, three research teams have just reported results that hold out the promise of advancement to the industrial stage. Two of them report among other things the production of "economically viable" ratios of human protein in the milk of sheep and goats.

"Transgenetics" is what makes animals capable of such alchemy. By means of complex genetic engineering, the mammals incorporate into their hereditary patrimony one or more genes ordinarily foreign to them. It is necessary to attach an "activator," a special genetic sequence, to the human protein gene which the animal is supposed to produce. The role of the activator is to regulate the functioning of the gene and to determine the kind of tissue (liver, mammary gland, etc.) in which it will "be expressed." Then several copies of the gene are injected with a micro-pipette directly into the embryo, which has been removed from a female after fertilization in vivo. Finally, the eggs are reimplanted in a female "surrogate gestator."<sup>1</sup>

According to the studies published in *BIOTECHNOLOGY*, a transgenic ewe was able to produce more than 60 grams of alpha-1-antitrypsin per liter of milk. Alpha-1-antitrypsin is a human protein prescribed in the treatment of emphysema. Production was subsequently stabilized at about 35 grams per liter. This "record" was set by the Pharmaceutical Proteins company (Edinburgh, United Kingdom). In all, the Scottish team was able to

obtain four transgenic ewes each producing more than 1 gram of the protein per liter of milk. Pharmaceutical companies consider this an economically viable production ratio.

### Genetic Alchemy

Another team composed of researchers from Tufts University (Grafton, Massachusetts) and the Genzyme Corporation (Framingham, Massachusetts) has succeeded in producing another protein, tPA (Tissue Plasminogen Activator), from the milk of a transgenic goat. That enzyme, which is able to dissolve blood clots, is used in the treatment of myocardial infarctions. Production levels have reached 3 micrograms per milliliter, a negligible quantity. But the researchers claim in their article that this level has since been exceeded by another animal that produces 2-3 grams of the protein per liter of milk (current technologies cannot control precisely where in the genome the foreign gene will be integrated, a variable that influences protein production).

Finally, a third team, from the Netherlands, composed of researchers from the University of Leyden and the Gene Pharming Europe company, has produced a transgenic cow that carries the gene for human lactotransferrin, a protein that transports iron and has antibacterial properties. Nevertheless, the male will not produce this protein, which under normal circumstances is "expressed" only in the mammary gland of a female. But its future offspring might have a better chance.

Yields from these processes are still small. By altering 100 mouse embryos, one can hope to obtain two to five transgenic baby mice. The proportion is smaller for the other mammals. For example, in the study by the Scottish team, 549 sheep embryos had to be altered to obtain five transgenic animals. These techniques become particularly cumbersome with cows, which are nevertheless of considerable interest because of the volume of milk they produce.

Manufacturing cost estimates for transgenic animals obtained by the micro-injection method range from 30,000 French francs [Fr] for a rabbit to Fr300,000 for a sheep and Fr2.5 million for a cow. In the Dutch study, researchers succeeded in lowering the cost of transgenic calves by removing ovocytes from female slaughterhouse cattle. The ovocytes were then matured and fertilized in vitro, rather than in vivo.

### Transgenic Rabbits

In France, the National Agronomic Research Institute (INRA), in association with Transfusion Merieux Innovation (TMI) and the National Blood Transfusion Institute, are trying to design transgenic rabbits that can produce Factor VIII, a protein essential to blood coagulation, and erythropoietin, a protein that stimulates red corpuscle production. The milk production from these rabbits, about 200 milliliters per day, makes them good candidates for producing limited quantities of certain

necessary proteins. Their speed of production and low cost also argue in their favor.

"With 300 lactating females," explains Mr. Louis-Marie Houdebine, research director at INRA, "one can hope to obtain a kilogram of recombinant proteins<sup>2</sup> per year. But we must make suitable partnership arrangements with manufacturers if we hope to develop this method on a large scale. Between now and the end of 1992 we hope to obtain the progenitor rabbits of lines capable of producing several grams of erythropoietin or Factor VIII per liter of milk." For the moment, INRA's rabbits are only producing alpha-1-antitrypsin in blood, which as a "biological fluid" is clearly less useful than milk, since the latter is easily renewable.

In years to come, it is believed that 35 human proteins might be produced from the milk of transgenic animals. Among the most likely candidates are alpha-1-antitrypsin, erythropoietin, human growth hormone, tPA, Factors VIII and IX, the C protein, and albumin. Currently, human proteins are obtained through genetic engineering and various other techniques. Some of these substances, such as Factor VIII, can be extracted from human blood plasma. Others, such as erythropoietin, are produced from mammal cell cultures. And still others are produced from cultures of bacteria or insect cells. In this panoply of techniques, each has advantages and disadvantages, depending on the protein concerned. And cost must be the determining factor in the choice of technique.

At present, we are still far from the industrial phase. Though the work of some research teams is quite advanced, products must still undergo clinical testing procedures, which could be lengthy and complex, before being licensed to sell on the market.

#### Footnotes

1. The female in question is first mated with a vasectomized male, so that hormonally she will be prepared to accept the altered embryo.
2. A recombinant protein is a protein manufactured by a gene that has been transferred into a foreign organism.

#### German University Plans Crystallization Plant

91MI0538 Duesseldorf *HANDELSBLATT in German*  
19 Sep 91 p 11

[Article by Christine Backhaus: 'Bremband' Operates in Harmony With the Environment]

[Text] Process engineers at the University of Bremen have worked with industry to develop a new layer crystallization plant for high-purity preparation of organic substances. The apparatus, which separates multicomponent mixtures, including, not least, problem waters, into their individual components, contrasts completely with previous crystallization techniques.

The leader of the scientific team that controlled the project, Joachim Ulrich, explained that for industrial

applications the plant is particularly economical in terms of time and energy, besides meeting the stringent environmental requirements that have come into force.

The plant, costing half a million German marks and named after its native city, has recently been shown at the International Workshop on Industrial Crystallization in Bremen. Its innovative technology was developed in collaboration with the Swedish Sandvik group and the Swiss Sulzer company. The plant's main component consists of a rotating steel belt on which the layer crystallization takes place. The conveyor belt, located in an enclosed system, operates with four separate cooling areas; only a small part, the conveyor belt, has to be heated or cooled rather than the whole apparatus.

This is where the major saving is claimed to lie. In addition, the plant is designed to avoid polluting the environment even in the event of a breakdown. Its present capacity is reported as seven to 10 kilograms per hour, and its operation as being sufficiently flexible to adapt to a wide range of products. Its range of potential applications includes, according to the inventors, chemicals, pharmaceuticals, foodstuffs, and textile raw materials.

Margarine production is an example of how the plant can be used to advantage. To eliminate undesired coloring, odor, and taste, palm oils to date required treatment with organic solvents. However, a new EC directive prohibits their use in foodstuffs manufacturing. According to Ulrich, the "Bremband" can now "bring the pure fat for the margarine to the top in crystal form, collecting the waste below."

Major chemical concerns have already indicated their interest, reports Ulrich. The demand for materials with very high degrees of purity is rising constantly, especially for high-tech products, and the costs incurred in avoiding environmental risks are increasing. This is precisely where the "Bremband" plant can bring benefits. For small and medium-sized enterprises engaged in materials conversion processes too, the plant promises to be a worthwhile investment on account of its flexibility, says Ulrich. Trials will take place during the next few months to determine the precise areas and materials for which the plant is economically viable.

#### Germany: BMFT Funds Biotech R&D at Small, Medium Companies

91MI0570 Graefelfing *BIOENGINEERING*  
*FORSCHUNG & PRAXIS in German* Aug 91 pp 7-8

[Excerpts] The Federal Minister of Research and Technology (BMFT) has presented a new indirectly-targeted funding program for biotechnology in small and medium-sized enterprises with a view to maximizing this key technology's impact on the development of new products and processes. 100 million German marks

[DM] are earmarked for this purpose over the five-year period commencing 1 July 1991. The program remains subject to EC approval.

According to EC estimates, the world market for biotechnological products (excluding foodstuffs and drinks produced by fermentation, such as cheese and beer) will triple in value to about DM50 to 80 billion between 1985 and 2000. This places great demands on small and medium-sized enterprises in terms of upgrading and innovation management, requiring a high degree of interdisciplinary R&D cooperation between biologists, chemists, and process engineers.

For many medium-sized firms, going into biotechnology involves substantial financial risks. Analyses of German industry's technological competitiveness confirm that biotechnology has not yet achieved widespread industrial application. Internationally, Germany is currently in third place, with 13 percent of patent applications filed in more than one country, compared with 42 percent for the United States and 18 percent for Japan. Annual R&D expenditure on biotechnology by German industry currently amounts to about DM250 million, compared with about DM1.3 billion in state funding, which is spent overwhelmingly on expanding basic research and training young scientists. Industry thus accounts for only 16 percent of total R&D expenditure on biotechnology, compared with the private sector's 64 percent share of the overall national R&D budget. The conditions for greater involvement by industry in biotechnology research and development have greatly improved. The law on genetic engineering passed last year provides a reliable and reliably calculable legal framework for the exploitation of genetic engineering in industry and for genetic engineering research.

#### **Using Modern Technology to Strengthen the New Laender**

As numerous BMFT enquiries have shown, a large potential in terms of firms using biotechnological production processes is emerging, and it is these that the program will support. Modern technologies such as biotechnology have a particular potential for contributing to the economic reconstruction and expansion that are so urgently needed. The broad range of topics included in the program and its simplified procedures, such as the flat-rate costing and clearly set-out application procedures, are particularly attractive for applicants in the new laender.

#### **Outcome of Previous Indirectly-Targeted Biotechnology Program Entirely Positive**

The Battelle Institute in Frankfurt/Main has analyzed the effectiveness of the previous indirect-specific program, which ran from 1986 to 1989. The researchers ascertained that 220 firms had been funded through nonbureaucratic, swift channels, high launch and acceleration rates had been achieved, and only a limited parasite effect [Mitnahmeeffekt] could be detected. Although the first indirect-specific program had been

open to biotechnology firms of all sizes, it had had the most beneficial effect on small and medium-sized industrial enterprises: More than 90 percent of the firms had an annual turnover of less than DM200 million.

In its report, the Battelle also established that more than 80 percent of the companies questioned had created new jobs. (In a random sample, 103 new posts for qualified employees had emerged in 22 of the companies interviewed.)

In 1990, two events in Bonn and Juelich demonstrated how extremely demanding projects in small and medium-sized companies were funded under the first indirect-specific funding program. The biotechnology firms that had received funding presented their results in a total of 57 reports. They included the development of genetic engineering-based methods for diagnosing various diseases (e.g., hepatitis) and modern biotechnological processes for studying pollutants in the environment and for analysis in food technology. In many cases the program was instrumental in establishing and extending contacts between small and medium-sized enterprises and universities.

The Battelle study drew the conclusion that the indirect-specific funding scheme had proved particularly well-suited to small and medium-sized enterprises. On the other hand, the effectiveness analysis showed that the three-year term of the first indirect-specific program had been too short. Biotechnological developments are not only time-consuming, they often also require a longer preparation time than other technologies. A new indirect-specific program with a five-year term is therefore now being launched.

#### **The New Program**

The new indirect-specific funding scheme will bring into effect a further part of the Biotechnology 2000 program adopted in 1990. One of the aspects of this program consists in rendering basic research findings exploitable at an early stage for technological development purposes, thus enhancing the competitiveness of the German economy, and small and medium-sized enterprises in particular.

Indirect-specific programs fund projects on suitable topics via a simplified procedure whereby mainly small and medium-sized enterprises from several branches of industry can be involved. Indirect-specific programs are designed to trigger a domino effect and foster private initiative.

Unaffiliated enterprises with an annual income of less than DM1 billion that are already engaged in biotechnology work or meet the basic qualifications for entry into this field are eligible to apply. The funding quota is 40 percent and the maximum grant is DM600,000.

An additional incentive will be granted for joint R&D projects involving at least two enterprises and at least one R&D institute. In this case the maximum grant is

DM1 million per company. Thus financial recognition will be given to the high level of interdisciplinarity inherent in biotechnology, the often high investment costs, and the need to cooperate with external R&D establishments.

A wide range of new biotechnology applications has evolved as a result of the swift advances of knowledge in this field. The indirect-specific program thus covers a wide range of topics. Financial aid will be provided for projects that aim to develop:

- New apparatus and equipment for use in biological research and production;
- Safety and disposal processes relevant to biotechnology;
- New biological environment technologies;
- New enzymatic processes;
- Products and intermediate products using new cell culture and molecular biology methods;
- New biotechnological processes for diagnostics, quality enhancement, and disease resistance in livestock breeding;
- Biotechnological processes for the use of raw materials of agricultural origin in the nonfood sector.

#### **Tomorrow's Chemical Industry: Intelligent, Gentle, Environment-Compatible**

The chemical industry makes a major contribution to Germany's strong competitive position, accounting for around a sixth of overall export sales from manufacturing industry. The chemical industry gave yet another impressive demonstration of its innovative strength at the Achema fair, where 3,200 exhibitors (two-thirds of whom were German) presented their latest chemical engineering and biotechnology products. With 6.1 percent of total income spent on research, the German chemical industry is far more research-intensive than industry as a whole, accounting for almost 20 percent of all Germans employed in industrial research and development. However, the chemical industry is now standing on a major threshold: tomorrow it will, more than ever, be a gentle, environment-compatible industry learning from nature, and its future shape will be molded by microelectronics and biotechnology. Information technology will be used to direct traditional areas and production processes towards customized, environment-compatible products; chemical processes will be optimized. The packaging industry will require biologically degradable plastics. Renewable raw materials are being considered as alternatives to their fossil-based counterparts. Tomorrow's chemical industry will be, more than ever, an "intelligent" industry. It thus epitomizes changes wrought by high-tech development. BMFT research policy takes full account of it.[passage omitted]

#### **Federal Minister of Research and Technology (BMFT) Extends Biotechnology Funding**

Between 1982 and 1991 the BMFT more than tripled its support for biotechnology. Some DM274 million have

been allocated for biotechnology in 1991. The Biotechnology 2000 Program of August 1990 sets new priorities for future years:

- Genome research and molecular modeling as point of departure for molecular biotechnology;
- Neurobiological research;
- Biosensor technology and bioelectronics;
- Environmental biotechnology;
- Renewable raw materials.

Molecular biotechnology has a particularly promising future, as it can be used to identify the structures and functional principles of the molecules in cells and living organisms. The aim will be to develop techniques derived from nature for working with cellfree systems.

#### **Increased Commitment by German Industry to Biotechnology Needed**

From now onwards German industry must be encouraged to increase its commitment to biotechnology so that this promising major technology, which can create markets and jobs for tomorrow, is developed and applied in good time in Germany. German industry's growing involvement in biotechnology abroad should not be one-sided and jeopardize the future of biotechnology in Germany. On the other hand, involvement of this type can have beneficial medium-term effects for German industry, as it provides opportunities to use important knowhow abroad and to develop or expand markets.

Modern technologies such as biotechnology also have a particular potential for contributing to the much-needed economic expansion of the laender. The western German chemical industry's involvement in the new laender has been limited to date, although the Trust Agency is clearly willing to part with its long-standing charges provided they are rapidly privatized.

The above is a reminder of the BMFT's appeal to western German industry to allocate 5 percent of its research expenditure to utilizing the research capacity available in the new laender. For example its "contract research and development" program provides targeted incentives to do so. Only joint action by the state and industry can lay the foundation for steady medium-term economic growth, which will enhance competitiveness, create jobs, and lead to uniform living standards throughout Germany.

A detailed description of the program can be obtained on request from: Project Leader for Biology/Energy/Ecology, Biology Section, BEO 21, Juelich Research Center GmbH, P.O. Box 1913, 5170 Juelich 1.

#### **DEFENSE R&D**

##### **Thomson-CSF, Euromissile Cooperate on Anti-Aircraft Missile**

91WS0540C Paris LE MONDE in French  
5 Sep 91 p 23

[Article: "Thomson-CSF Joins Forces With Euromissile in the Anti-Aircraft Missile Sector"]

[Text] On Thursday 5 September, Euromissile, the French-German economic interest group [GIE] regrouping the Aerospatiale group, the Messerschmitt-Boelkow-Blohm company (a subsidiary of Deutsche Aerospace), and the Thomson-CSF group, will announce their collaboration in the anti-aircraft missile sector (see our late editions of 4 September). At first, the three partners will cooperate on the Crotale NG short-range ground-to-air missile program. Later, they will attempt to achieve a better coordination of their missile programs within a European context, due to military budget cuts, the increasing rarity of potential purchasers, and the ever keener competition on foreign markets.

This alliance became possible after Euromissile and Thomson-CSF, each on their own, disentangled themselves from the industrial partnerships on ground-to-air missiles to which they had previously committed themselves.

In May 1990, the Euromissile GIE and the French group Matra [Mechanics, Aviation, and Traction Company] had planned to develop, at their own expense, a new hyper-velocity ground-to-air missile, the RM5, based on the existing Roland. Their alliance was intended to counter Thomson-CSF's association with the British Aerospace group on the Eurodynamics project, announced in 1989 and geared to the same anti-aircraft weapon sector. Already then, the French Ministry of Defense had seemed to disapprove that three French companies should compete with one another through inter-European cross-cooperation agreements.

Last March, however, Thomson-CSF gave up its trans-Channel agreement and, a only a few days ago, Euromissile (without Matra, which just acknowledged the fact) postponed to an unspecified date the development of the RM5 missile, saying it had to review the market and its own results.

This dual withdrawal actually prefigured what some have called a new deal among manufacturers. By working together, Euromissile and Thomson-CSF appear to want to exclude Matra from the sector, although it manufactures the Mistral short-range ground-to-air missile (6,000 missiles sold to date to 11 clients). In addition to the air-to-air missiles for which it has near exclusivity in France, the Matra group is still collaborating with Aerospatiale on the development of the Apache air-to-ground missile—the equivalent of a cruise missile fired from a safe distance—that should equip the Rafale aircraft.

## ENERGY, ENVIRONMENT

### Berlin Receives Ecological Funding From EC

92WS0051A Brussels EUROPE in English  
20 Sep 91 p 11

[Article: "(EU) State Aid: The Commission Approves Aid for Environment-Friendly Activities in Berlin"]

[Text] Brussels, 19/09/1991 (AGENCE EUROPE)—The Commission has approved a notified State aid programme

in Berlin running until 1993, with, for 1991, a budget of 6.9 million German marks [DM], or 3.34 million European currency units [ECU]. The Commission judges this programme to be in line with the Community environmental policy objectives, as well as its aim to promote SMEs [small and medium-sized enterprise].

The programme involves:—grants to cover environmental consultancy costs incurred by companies with an annual turnover of DM60 million (ECU29 million); - promotion of environment-friendly and innovative investments, with aid being given in the form of equity, subsidised loans and conditionally repayable grants to companies with an annual turnover of ECU24 million carrying out such investments; - grants and subsidised loans given to companies with maximum of 500 employees that implement pilot projects demonstrating ecologically acceptable production processes; equity, conditionally repayable grants and soft loans are granted to enterprises that restructure their production processes to comply with environmental norms; grants awarded to companies with an annual turnover of ECU24 million to help them market environmentally friendly products.

### Status of German Atmospheric Protection Research Reviewed

91MI0509 Bonn TECHNOLOGIE-NACHRICHTEN  
PROGRAMM-INFORMATIONEN in German  
5 Aug 91 pp 1-12

[Interim appraisal by the BMFT [Federal Ministry of Research and Technology] of the implementation of the report by the Commission of Enquiry on Preventive Measures to Protect the Earth's Atmosphere]

### [Text] Introduction

The BMFT, together with scientific circles, has reacted in good time and initiated appropriate research programs on the current global issues of:

- Destruction of the protective ozone layer in the stratosphere, and
- Possibility of climate change resulting from the increased anthropogenic greenhouse effect.

These steps have been taken in close collaboration with the German Bundestag Commission of Enquiry on Preventive Measures to Protect the Earth's Atmosphere, which submitted its third report "Protection of the Earth" on 5 October 1990 (Bundestag Paper 11/8030).

The three reports on "Protection of the Earth," which cover the destruction of the ozone layer, the greenhouse effect, and the destruction of tropical forests, together with a catalogue of measures, probably represent the most extensive status report on the current world situation. The first report concentrated primarily on ozone depletion, the greenhouse effect, and climate change, the



second report on the role of the tropical rain forests, and the third focused more closely on measures, particularly in the field of energy.

The reports highlight the ways in which the views of the commission of enquiry and the action taken by the BMFT regarding climate research, ozone research, CO<sub>2</sub> emissions, and energy are being or have been coordinated, and what provisional conclusions can be drawn.

## **I. Greenhouse Effect and Climate Change**

### **A. Need for Climate Research Emerging From the Commission of Enquiry's Report**

Additional need for research is identified in the following areas:

#### **1. Distribution and Trends of Directly and Indirectly Climate-Relevant Trace Elements and Climatic Parameters**

- Evaluation of long-term climate data and paleoclimatological data;
- Measurement of the global distribution and chronological modification of climate-relevant trace elements in the troposphere and stratosphere by means of satellites, airplanes and clean-air units;
- Recording of climate-relevant parameters (distribution of vegetation, ground temperature, and humidity);
- Role of aerosols.

#### **2. Emission and Precipitation of Climate-Relevant Trace Elements**

- Evaluation of cycles of trace elements of natural (C) and anthropogenic (CH<sub>4</sub>, N<sub>2</sub>O) origin;
- Climatic compatibility of automobile exhaust gases from catalyzers;
- Role of CFC [chlorofluorocarbon] substitutes in ecosystems;
- Effects of air transport;
- Reactions in the atmosphere, particularly heterogeneous chemical reactions, leading to alterations in chemism in the atmosphere;
- Information on the major trace gas emissions;
- Interaction between global troposphere chemistry and the biosphere in regard to trace element balance;
- Measurement of natural and anthropogenic emissions and distribution of trace elements, and their evaluation on a regional and nonregional basis;
- Investigation of trace gases that influence the chemistry of the troposphere and, consequently, the flow of halogenated hydrocarbon into the atmosphere among other factors.

#### **3. Climate Modeling**

- Development of three-dimensionally coupled climatic models, including chemistry and the carbon cycle;

- Improved parametering of radiation processes and clouds;
- Validation of results of models using global data, comparisons of models, tests of model quality;
- Model computation for differing trace gas scenarios;
- Improvement of regional definition.

#### **4. Research Into the Effects of Climate**

In addition to the effects of the climate on natural ecosystems, the need for research revealed in the commission of enquiry's report also covers the socioeconomic effects of climate changes at national and international level.

The following are examples of areas requiring future research:

- Natural ecosystems (ground erosion, water quality, water regime in rivers);
- Source and sink rates for major climate-relevant trace elements;
- Emission reduction measures;
- Displacement of vegetation zones;
- Agriculture and forestry;
- Effects of increased CO<sub>2</sub> concentrations;
- Chemistry of the troposphere, changes undergone by the troposphere;
- Economic and sociopolitical questions;
- International economic and political relations.

### **B. Present and Future Work by the BMFT**

So far, 78 projects (including some major joint projects) have been funded or are currently receiving funding in the more specific area of climate research.

The BMFT's expenditure on climate research has risen from 6 million German marks [DM] in 1982 to DM53 million in 1990, including both project funding and the work undertaken in this area by the major research institutes. This amounts to some DM300 million for the whole year, including some DM55 million for the DKRZ (German Climate Computing Center) alone—far more than the other European countries spend on climate research. In parallel, atmospheric research has also been stepped up, with the result that more than DM100 million were available in 1990 for climate and atmospheric research funding.

The need revealed by the commission of enquiry for additional research on the greenhouse affect, is widely known and has already been partially addressed by the structuring of the BMFT's "Greenhouse Effect" funding program (initiated in 1989). More specifically, it covers:

#### **1. Distribution and Trends of Directly and Indirectly Climate-Relevant Trace Elements and Climatic Parameters**

Terrestrial and marine paleoclimatology already has a certain "tradition" (total expenditure to date approximately DM17 million) and is being pursued as part of



the greenhouse effect funding program (about DM15 million 1991 - 1993). Research on the distribution and trends of climate-relevant trace elements (gases and aerosols) falls within the greenhouse effect program. A scientifically coordinated joint project is currently being drawn up.

The recording and distribution of climate-relevant parameters showing the interaction between temperature, ground humidity, and vegetation are carried out in exemplary fashion in the field campaigns that form part of the joint Land Surface Climatology project (expenditure around DM8.3 million to 1991). These studies will be stepped up in the future as part of the IGBP (International Geosphere Biosphere Program) core project BAHG (Biospheric Aspects of the Hydrological Cycle); the content of the project is currently being defined.

## 2. Emission and Precipitation of Climate-Relevant Trace Elements

As with trace element distribution and trends, trace element cycles will be studied as part of the future joint project referred to under 1 above.

Attention is drawn in this connection to the EURO-TRAC [European Experiment on Transport and Transformation of Trace Elements] program initiated in 1985 as a EUREKA [European Research Coordination Agency] project, on which Germany has spent DM50 million for 52 projects. Its first objective is to study the chemical processes whereby air pollutants, including climate-relevant trace elements, are converted and transported.

In addition, the joint research project entitled "scientific support program for purifying the atmosphere above the new laender" (SANA), which has so far received some DM10 million in funding, is equipped to record and track significant environmental changes following on changes in emission levels. The aim of this project is:

- To bridge the existing gaps in knowledge concerning the transport, conversion, and effects of pollutants;
- To assess measures taken to reduce emissions;
- To develop dynamic chemical models (including heterogeneous chemistry) to determine cross-frontier transport, emission, and precipitation of, primarily, emitted and, on a second level, created pollutants;
- To utilize the results achieved in close collaboration with other joint projects to assess effects on the environment (natural ecosystems, living conditions etc.);
- To devise efficient emission reduction strategies.

The BMFT will address the remaining topics (automobile exhausts, CFC's, aviation) during its discussions with the Federal Government's Scientific Climate Advisory Council, and incorporate them into its programs and priority areas where appropriate.

## 3. Climate Modeling

All the subsidiary topics mentioned by the commission of enquiry are being addressed in larger joint projects ("climate modeling and climate diagnosis," "radiation and clouds," "scenario computation," overall funding for which amounts to some DM12.3 million from 1990 through 1992.

A major facility in this connection is the German Climate Computing Center" (DKRZ) in Hamburg, founded in 1988 as a supra-regional service providing computing time and technical support for simulations with sophisticated numeric models for scenario computation and climate forecasts. The BMFT bears the investment costs and part of the running costs arising from the BMFT-funded climate research projects.

Internationally, the DKRZ is one of the largest computing centers devoted solely to climate research.

There is a certain shortfall in capacity for validating results achieved with models, as specialized teams are presently in the process of formation and are thus not yet able to accept applications, while existing good teams are overwhelmed with work.

Research groups from the former GDR (Heinrich Hertz Institute of the Academy of Sciences, Humboldt University in Berlin, and the Meteorological Service) have climate diagnosis expertise and skills that will be utilized in the future.

The commission of enquiry's report mentions no causes of climate change that have not been or are not currently topics of BMFT funded research.

## 4. New Funding Program: "Research Into the Effects of Climate"

Changes to the earth on a global scale that may result from causes including climate change are a matter of public interest and concern. The public expects politicians to adopt appropriate measures making for successful adaptation to unavoidable climate changes. In addition to research into the causes of climate change and the interaction between various scientific phenomena, the effects on the economy and society must be investigated. The BMFT intends its funding program on "effects of climate change on ecological and sociocultural systems" to represent an identifiable German contribution to international global change research.

In accordance with the commission of enquiry's recommendations, the following areas are therefore being addressed:

- Effects of climate change on water supplies;
- Direct effects of anthropogenic trace elements;
- Effects of climate changes in the past;
- Effects of climate in natural ecosystems;
- Effects of climate change on the economy and society.

Every effort will be made to bring the projects into line with the aims of the IPCC (Intergovernmental Panel on Climate Change). Bringing national projects together on

a global scale will be simplified by using compatible analysis methods and data formats. Appropriate guidelines are presently being devised by IPCC working party II on "impacts assessment."

At the start of October 1990, the BMFT held a workshop bringing together about 50 scientists to define a funding program on "research into the effects of climate." The topics thus identified coincide with the research requirements listed by the commission of enquiry.

A funding concept is currently scheduled for presentation by the end of 1991, although research is already under way in the following areas:

- Climate change and north German coasts (including coastal areas);
- Climate change and agriculture.

## II. Ozone Depletion in the Stratosphere

### A. Need for Ozone Research Emerging From Commission of Enquiry's Report

1. Coordinated, systematic work on aspects of the present BMFT ozone research program, particularly in cooperation with international scientists, appears sufficient in the short term to reveal the extent and the causes of ozone changes resulting from CFC's and other ozone-damaging substances.
2. The following remain unexplained and largely unsearched:
  - Changes in UVB intensity near ground level and effects that they produce;
  - Influence on the stratosphere of present and future air traffic in terms of the increase in trace elements that produce chemical and climatic effects ( $H_2O$ ,  $CH_4$ ,  $N_2O$ ,  $NO_x$ , particles).

The commission of enquiry therefore considers it a matter of great urgency that the current ozone research program be rapidly expanded to include the following research work:

#### (a) Changes in UVB Intensity and Effects on Atmospheric Chemistry:

- Development and installation of high-resolution UVB spectrometers with long-term stability at appropriate locations in the Federal Republic of Germany (North Sea islands, Hohenpeissenberg, Zugspitze), Spitsbergen (Ny Aalesund), and in tropical latitudes. These stations will be integrated into the international network and calibrated against one another at regular intervals. They will also possess measuring equipment to determine the vertical ozone profile, aerosol content, and degree of cloud coverage.
- Studies of modified UVB intensity and changes in the distribution of the trace elements  $O_3$ ,  $SO_2$ ,  $CO$ ,  $CH_4$ , aerosols etc. in the chemistry of the troposphere.

#### (b) Effects of UVB Rays on Human Beings and Terrestrial and Aquatic Ecosystems:

- Link between increased UVB radiation and skin cancer;
- Effects on the immune system;
- UVB-sensitivity of natural ecosystems and commodity plants at various geographical latitudes;
- Adaptation mechanisms in plants;
- Relationship between increased UVB radiation and other environmental factors;
- Depth of UVB radiation penetration into the net primary production of phytoplankton;
- Direct/indirect effects on other links in the marine food chain.

#### (c) Regional and Global Modifications in the Chemical Composition of the Stratosphere (above 10 km) and Upper Troposphere (approximately 8 - 10 km.):

- Quantification of the relevance of emissions ( $H_2O$ ,  $NO_x$ , etc.) from aircraft for the ozone and water vapor contents of the stratosphere and the upper troposphere;
- Atmosphere cycles and possible trends of propellant gases from stratospheric sulfuric acid aerosols;
- Transport of substances between the troposphere and lower stratosphere;
- Effect on the climate.

This requires:

- Availability at short notice of long-range aircraft with sufficient ceiling (stratospheric aircraft capable of flying at 20 km altitude); this latter requires technological development work;
- Increased work on the heterogeneous chemical conversion of ice and nitric acid hydrate crystals and ( $H_2SO_4$  aerosols).

### B. Present and Future Work by the BMFT

The BMFT, in close collaboration with the commission of enquiry, has already initiated part of the requisite research work:

#### 1. Ozone Research Program

Launch of the ozone research program at the end of 1988; the program, scheduled to run for a minimum of five years, is intended to:

- Establish the nature and extent of changes in the ozone concentration;
- Identify the causes of these changes;
- Form a basis for reliable forecasts for future developments.

Field surveys and laboratory experiments are being carried out and mathematic models developed for this purpose. The ozone research program is concentrating on the northern hemisphere, with special reference to the

north pole area. The desired cooperation with the European ozone research program has got off to a satisfactory start.

Around 26 projects involving total expenditure of some DM25 million, plus approximately DM8 million for TRANSALL operating costs, have been approved. A two-day briefing seminar on the status of current projects in the ozone research program took place on 13/14 June 1991.

Another 21 projects (costing some DM15 million) have been proposed (13 of which have so far been assessed positively) and are expected to be approved. A large proportion of the projects relate to the major European Arctic Stratosphere Ozone Experiment (EASOE) planned for winter 1991/92.

The TRANSALL project accounts for a major share with, at present, three remote sensing and two direct sampling experiments (the sensors cost about DM7 million, and the TRANSALL operating costs will amount to around DM8 million over five years). The sensors have already been successfully operated on the TRANSALL in field conditions in polar regions in January/February and again in April 1991, so they will be available for operation under the EASOE project.

Until then, TRANSALL will be able to operate from Norway, Sweden, and Greenland. Applications are currently being made for landing permission in Arctic territories (Iceland, Canada, and the Soviet Union), so as to ensure optimum meteorological conditions (position/motion of the polar vortex) for the surveys.

#### *2. European Arctic Stratosphere Ozone Experiment (EASOE) Pollutants Arising From Aviation*

The BMFT is currently considering the nature and extent of financial support for the national research and technology program on "pollutants arising from aviation" proposed by the DLR [German Aerospace Research Institute]. The purpose of the joint project planned by science and industry, and which will cost about DM200 million (with science's share amounting to about DM20 million) over 10 years is to:

- Study the climatic and atmospheric effects of pollutants from aircraft engines, and
- Achieve a drastic reduction in pollutants by developing new combustion chamber designs and propulsion concepts.

#### *3. Ecological Research Aircraft*

A survey among ecological research aircraft users is investigating whether additional aircraft capacity is needed; a need is currently emerging in stratospheric research (ozone research program, aviation) for long-range aircraft with large payload capacity and for a high-altitude stratospheric aircraft (Strato 2c); the findings of the survey will be presented in July 1991.

#### *4. New Support Priority "UVB Measurement"*

A workshop was held at the BMFT in February 1991 to define modelers and researchers' requirements for UVB measuring equipment. Matters relating to the installation of a measuring network were also addressed.

R&D projects on UVB measurement or development of measuring methods have hitherto been regarded as part of the UVB effect program. Now that a link has been revealed between an increased UVB dose and a measured reduction in the ozone layer, this area will now be integrated into the ozone research program. In view of the urgency of the task, consideration is being given, pending development of sufficiently accurate measuring apparatus, to installing "interim apparatus" at a limited number of measuring stations.

The draft program is scheduled for completion by the end of this year and will be approved by the Federal Government's Scientific Advisory Panel on the Climate. Funding is expected to commence in 1992.

#### *5. New Funding Program: "Effects of Increased UVB Radiation"*

Since 1978, the BMFT has carried out 25 projects funded with DM11.3 million on "biological consequences of increased UVB radiation." Research carried out under these funding measures has focused mainly on how increased UVB radiation affects aquatic plants, microorganisms, and terrestrial plants.

The BMFT is drawing up an interdisciplinary research funding program to investigate the effect of UVB radiation on entire ecosystems.

This program will complement the ozone research program, which concentrates on the results of UVB ground pollution measurement and understanding the causes and trends of this pollution. It will thus provide essential input data for laboratory and field studies. The effects of increased UVB radiation and their mechanisms will be studied in the following contexts:

- Chemistry of the troposphere;
- Aquatic ecosystems;
- Terrestrial ecosystems;
- Human health.

Funding for the applicants, presently totaling eight, will begin in the second half of 1991 and amount to approximately DM5.5 million.

### **III ATMOS (Atmospheric and Environmental Research Satellite)**

#### *A. ATMOS Recommendations Made by the Commission of Enquiry*

The Federal Government was requested to introduce all necessary measures to bridge the gap in satellite data expected to arise from 1994 in atmosphere and environmental research and to this end to press for a European satellite or, should this not be feasible in time, comparable national satellite.

## **B. ATMOS Status of the BMFT's Work Under the ATMOS Program**

### **1. The ATMOS Concept**

Preparations for the ATMOS program, which, in addition to the space sector also includes the earth sector, the creation of an ATMOS data utilization center, a user secretariat, and data utilization, has been successfully completed. The purpose of the 10-year German-led international program is to provide and utilize global data records from ATMOS-type satellite to investigate current global change issues.

The strengths of the ATMOS as now defined are that:

- Three instruments operating in different wavelength ranges (UV-IR) and using various sensor technologies will make it possible to perform simultaneous, high-resolution measurements on a large number of entire trace-gas families from the same volume of air;
- The earth's surface will be observed (trace gas sources, biomass production) and tropospheric trace gases will be measured simultaneously.

In addition to bridging the data gap between the UARS (Upper Atmospheric Research Satellite) and the ESA POEM (Polar Orbiting Environment Mission)-1, it will primarily achieve added scientific value.

New insights into the interaction between biosphere and atmosphere and the chemical and dynamic link between the planetary boundary layer, the troposphere, and the stratosphere are expected. Furthermore, understanding of the chemistry of trace gases that lead to a reduction in the stratospheric ozone layer will be considerably improved.

The international scientific community underlined the importance of ATMOS at an ATMOS workshop held on 21 and 22 January 1991.

### **2. ATMOS Development Status**

The B1 Study phase was concluded at the end of January this year. The outcome was that the ATMOS program was considered feasible and that the mission could meet the scientists' requirements.

So as to further the concept of the ATMOS program through international cooperation, the BMFT has decided to initiate further feasibility studies as part of a B2 phase to be undertaken by DARA [German Space Agency] (DM12 million allocated for the 1991 budgetary year, scheduled term: to the end of 1991).

## **IV Research Into Reduction of Halogenated Hydrocarbon Emissions**

### **A. Need for Research Into Halogenated Hydrocarbon Emerging From the Commission of Enquiry's Report**

The measures proposed by the commission of enquiry are largely limited to political measures for reducing

halogenated hydrocarbon emissions; the need for R&D on replacing these substances is implicit. Shortfalls in research are not specified.

### **B. Present and Future Work by the BMFT**

The BMFT funding program on "reduction of halogenated hydrocarbon emissions" was announced in May 1989.

Under this program, the BMFT is supporting R&D on "cleaning processes," "plastic foaming," and "refrigeration air conditions," with a total of 33 projects costing DM25 million. Apart from the refrigeration, where chlorine-free compounds only are considered, halogen-free substitutes are being investigated and introduced. These are mainly water-based media and aromatic-free heavy petroleum spirits for cleaning, and air, nitrogen, and CO<sub>2</sub> in the foaming of plastics. As of now, the major R&D areas are covered by funded projects; other funding measures should be limited to outstanding "niche" problems or unconventional solutions.

The major emission areas and areas of application to date are included in these R&D projects.

## **V. "Energy and Climate" Area**

### **A. Need for Energy Research Emerging From the Commission of Enquiry's Report**

Often only indirect research recommendations can be derived from the measures proposed by the commission of enquiry, which did not specify, either explicitly or implicitly, shortfalls in research.

#### **1. Renewable Energies**

- Alongside the opening up of markets for launch-ready renewable energies, work on renewable energies requiring considerable additional R&D is to be stepped up.
- Wind plants require about 10 years' more R&D work.
- Photovoltaics (PV) and solar-hydrogen (H<sub>2</sub>): owing to the long lead time several decades, market development and R&D must proceed in parallel.

#### **2. Photovoltaics**

- Increased energy effectiveness, to be achieved particularly by raising levels of efficiency and increasing use of combined power-heating plants.
- Measures for reducing methane emissions in hard coal and crude oil extraction, and the transport and distribution of national gas.

#### **3. Nuclear Energy (vote by group that considered the use of nuclear energy to be responsible)**

- Improving safety by developing safe light-water reactors and, as a possible alternative, high-temperature reactors.

#### 4. Heating

- Funding program for further training of, primarily, architects, planners, engineers, building and heating technicians, and building workers in optimizing buildings from the energy point of view;
- Funding for active and passive solar energy exploitation.

#### 5. Transport Sector

- Optimizing means of transport (in manufacture and operation) from the energy point of view and the technical measures for reducing emissions.

#### 6. Industry and Minor Consumption

- Manufacture and use of products and application of processes suited to reuse or recycling.

#### 7. Conversion Sector

- Improvement of levels of efficiency of power stations and combined heating and power stations.

#### B. Present and Future Work by the BMFT in the Major Areas

##### 1. Renewable Energies

Wind: large-scale 100MW/200MW demonstration projects, new production techniques designed to reduce costs, and further development of key compounds.

Solar hydrogen: Improvement of electrolytic processes, photochemical  $H_2O$  production,  $H_2$  fuel cells, application of  $H_2$  for energy purposes.

PV: reduction of PV cell production costs, improvement of efficiency levels, thin-film technology, improvement of PV systems and applications technology. PV demonstration plants, 2,250-roof program.

##### 2. Fossil Energy Sources

- Basic research on combustion (e.g., Tecflam, Turboflam);
- Development of environmentally friendly and economically viable power station technologies, e.g., gas and steam (pressure gasification of coal), pressurized fluid bed technology, and pressure gasification of coal dust);
- Launch of future  $CO_2$ -conscious lines of development with 50-percent efficiency levels (pressure combustion of coal dust and dual vapor process using a potassium turbine).

##### 3. Nuclear Energy

- Reactor safety research as a preventive measure to ensure highest possible degree of safety;
- Decommissioning of nuclear facilities;
- Safety-related work for nuclear fuel cycle systems;
- Disposal;

- Advanced reactor systems.

#### 4. Domestic and Minor Consumption

- Development of transparent heat insulation to commercial levels;
- Controlled ventilation in house building;
- Recycling heat techniques using new materials;
- Active and passive solar energy exploitation;

#### 5. Rational Energy Consumption in Industry

- Advanced technical approaches to heat pumps and transformers;
- Ceramic heat exchangers for high temperatures;
- Oil/gas ceramic engines and stirling engine technology;
- Energy-saving sintering and deformation processes.

#### 8. Transport

- Reduction of energy consumption, e.g., through new designs;
- Replacement of mineral oil products, e.g., with hydrogen, methanol, ethanol, or replantable vegetable oils (rape-seed);
- Improvements to the traffic flow (PROMETHEUS [Program for a European Traffic System With Highest Efficiency and Unprecedented Safety]);
- Energy-saving drive systems with brake recovery;
- Optimized drive systems for short-range vehicles and rapid rail systems.

No research policy gaps or shortfalls were identified in the commission of enquiry's report. The BMFT's present and planned R&D work goes as far beyond the research area stated by the EC.

Since power generation is currently responsible for about 50 percent of the anthropogenic share of the greenhouse effect, direct or indirect climate gas reductions may be expected from all the areas of energy research mentioned below. This applies to both  $CO_2$ -free power generation (renewable and nuclear energy) and the rational consumption of energy from upgraded coal-fired power stations, rational energy consumption in transport. It is not possible to give a more detailed attribution to specify reductions in climate gas.

Renewable energy sources and rational energy consumption are receiving funding under energy research programs in the form of project financing and contributions from major research institutes amounting to about DM350 million in 1991.

In addition to R&D work, the BMFT is comprehensively pursuing the commission of enquiry's with its project on "tools for developing strategies to reduce energy-related climate gas emissions in Germany." The aim of the project on tools that interested users can use to simulate "strategies" for reducing emissions of selected climate-relevant substances. The substances concerned will probably be the gases  $CO_2$  and CO, water vapor,  $NO_x$ ,  $CH_4$

and other volatile hydrocarbons, CFC's, dusts, and aerosols. Drawing up particular strategies, to meet specific political prerequisites falls outside the projects's terms of reference, thus making it clear that the toolset is no substitute for energy policy. It is rather designed to assist in identifying technical options for a climate gas reduction strategy in boundary conditions, and to optimize those options, for instance by reference to a cost reduction approach. The major boundary conditions that must be taken into account include emission limits, price trends for raw materials and goods, capital availability and interest rates trends, the dynamics of innovation, and general economic trends for the initial year 1989 and the pivotal years 2005 and 2020.

The BMFT has also formulated a primary strategic approach to CO<sub>2</sub> reduction as a combination of tax exemptions, incentives, and sector-specific packages of measures (as recommended by the commission of enquiry), with financing from special funds targeted for specific CO<sub>2</sub> emission reduction measures, as follows:

1. Consistent expansion of nuclear power: 1 light-water reactor per year from 1997 as a substitute for brown and hard coal; approximately 7 percent;
2. Gas and steam stations, gas increasingly reduced for electricity generation: approximately 2.8 percent;
3. Combined heating and power stations, power-heat coupling, waste utilization, and renewable energies: approximately 2.1 percent;
4. Heat in buildings: approximately 8.3 percent;
5. Increased use of gas and exhaust heat exploitation in industry and minor consumption: approximately 2.1 percent;
6. Rational energy consumption in the industrial and domestic sectors: approximately 2.1 percent;
7. Transport: approximately 6.2 percent.

The total CO<sub>2</sub> reduction resulting from the Federal Government's guidelines amounts to 25 percent. The BMFT figures presented here are based on an interpretation of the papers submitted to date by the commission of enquiry and other studies.

#### **Closed-Cycle, Environment-Friendly Cellulose Production Method Studied**

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ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 30 Sep 91 p 8

[Article by Eberhard Zerres: "Closed-Cycle Process for Environmental-Friendly, Chlorine-Free Production of Cellulose; Production Using Organocell Process To Begin in Summer 1992; Reduction of Environmental Load Expected; Elimination of Sulfur"]

[Text] To meet the requirements for high-grade paper, it is necessary in varying degrees to continuously furnish new fibers. These fibers are produced mechanically as wood pulp, or chemically as cellulose pulp: The yield from mechanical digestion is very high; however, the process requires a relatively large amount of energy. Hydrogen peroxide, which is environment-friendly, is generally used to bleach the wood pulp; chlorine and chlorine compounds are not used.

The chemical digestion of cellulose from wood requires the use of chemicals to separate the cellulose fibers from the structure of the wood. These chemicals are then recovered and reused in the production process. Although the cellulose yield is only 50 percent, the process is generally self-sufficient where energy is concerned: Combustion of the non-usable woody fibers generated by the pulping process produces enough energy to run the cellulose plant.

The primary source of environmental loads during cellulose production is the cellulose bleaching processes, which follows digestion. During bleaching, the residual lignins are separated from the cellulose fiber mixture. This process is essential whenever those grades of white paper and carton are called for which will not discolor during storage, will not yellow in sunlight, and combine whiteness with durability. Of course, the paper itself is not bleached.

During the past several years, ecologists have demanded that the cellulose industry avoid bleaching methods that use elemental chlorine or, wherever possible, other chlorine compounds. Consequently, research into alternatives to chlorine bleaching is being conducted throughout the world. New wood digestion methods are being developed that yield a cellulose that can be bleached without using elemental chlorine or other chlorine components.

One of these new methods, the Organocell Process, is a development of the Organocell Association for Cellulose and Environmental Technology, mbH, Munich, a subsidiary of Technocell AG, Munich. The Organocell Process can be used to digest all types of wood, including pine as well as so-called annuals such as straw, bagasse, and kenaf.

The two primary methods used to produce cellulose are the sulfite process and the sulfate process. Sulfite cellulose, which is relatively light even in its unbleached state, can now be bleached using oxygen and oxygen compounds rather than the previously customary chlorine compounds. There are drawbacks to the sulfite cellulose process, however: The cellulose is of relatively low strength and only a limited number of wood types can be used. Most important, pine wood, of which Germany has a relatively untapped supply, cannot be used in this process.

Sulfate cellulose has important qualitative advantages over sulfite cellulose, above all with regard to strength. The drawback of this process is that in order to produce

fully bleached sulfate cellulose of the high quality demanded by the market, it is still necessary to employ a combination of elemental chlorine and chlorine compounds in the bleaching process. In modern bleacheries, of which there are still very few, the use of elemental chlorine may be avoided completely; however, chlorine compounds must still be used as a bleach. Modern bleaching methods based on oxygen or oxygen compounds are already adequate for the production of partially bleached, yellowish sulfate cellulose, the whiteness of which is considerably below the quality of fully bleached cellulose. Consequently, the sulfate cellulose is of limited use.

Cellulose plants using the sulfate process are prohibited in Germany, as even the smallest concentration of hydrogen sulphide, one of the by-products of the process, irritates the sense of smell, and it is difficult to dam up organic sulfuric hydrides. Furthermore, for safety reasons, sulfate cellulose plants in Germany are not permitted to use combustion furnaces to recover pulping chemicals.

In view of this problem, Organocell, after eleven years of research and development, has developed a process whereby cellulose can be produced, entirely without the use of sulfuric hydrides, from virtually all wood types as well as from the so-called annuals.

It has been known since around the turn of the century that alcohol and water at high temperatures can be used to obtain cellulose from deciduous trees. Organocell researchers built on this knowledge, refining it to the point where wood from coniferous trees can now also be considered a raw material. In the Organocell process, wood chips are saturated with an aqueous solution consisting of methanol and caustic soda, then digested in a pressure vessel for 60-90 minutes at approximately 170° Celsius. The resulting cellulose has a strength equal to that of sulfate cellulose and far exceeding that of acid-digested sulfite cellulose. This was successfully proved at Federal Ministry of Research & Technology (BMFT) demonstration facility.

A continually operating digester located in a Munich residential area produces up to five metric tons of cellulose daily, which is either used by Technocell to produce paper impregnated with synthetic resin or is sold elsewhere. Attached to the cellulose digesting plant is a blechery, in which the Organocell cellulose is bleached in three stages. In 1987, when the plant began operation, the primary objective was the development of a sulfur-free digestion process, as the threat to the environment posed by sulfur was well-known. Bleaching was included in the process in order that the cellulose be as marketable as possible. Today, the process has been developed to the point where the sulfur-free cellulose digestion process is well in hand, and attention can be focused nearly exclusively on the optimization of the bleaching process.

Oxygen, hydrogen peroxide, and chlorine dioxide are used to bleach cellulose; however, research during the past 12 months has been focused on the elimination of the chlorine dioxide step and the optimization of peroxide bleaching. Some 10 years ago, a cellulose plant of 300 daily annual tons output (dato) in Washington state was shut down because the cellulose was not as white as the market at that time demanded. However, today's environmentally conscious consumer is satisfied with the degree of whiteness that can be attained by bleaching with oxygen and peroxide alone. This was clearly demonstrated in market studies by manufacturers of diapers and other sanitary products.

The Organocell process proved so environment-friendly so early that the Organocell GmbH took over the Bavarian Cellulose GmbH plant in Kehlheim from Waldhof-Aschaffenburg Paperworks (PWA). The original plan was to close the plant, as the environmental burdens resulting from the acid sulfite process employed there had become intolerable. Presently, a factory designed for the Organocell process is being built on the site of Bavarian Cellulose, at a cost of approximately 350 million German marks [DM].

Organocell Thyssen, a joint subsidiary of Organocell and Thyssen Trade Union or Thyssen Rheinstahl Technology, is responsible for the planning, construction, and opening of the plant. Organocell Thyssen, which was established in 1988, is responsible for international marketing for Organocell plants.

The digesting plant - construction was completed in 1991 - is to be equipped with a continual Kamyr digester (at a cost of DM110 million) which requires much less energy than a batch system of equal capacity. The chemical recovery is based on a long-standing and often-used technology used in alkaline cellulose production the world over. No detail of the construction of the new digesting plant was left to chance; the design was based on the existing industrial plant, and any questions that arose were clarified at the demonstration plant. Construction is currently underway on a new blechery in which cellulose can be bleached in an environment-friendly manner entirely without chlorine or chlorine compounds.

The digester, an in-house development, is the heart of the new cellulose factory. When the new plant begins production in the summer of 1992, the environmental load caused by cellulose factories will decrease dramatically. Despite the fact that plant capacity will be increased from 65,000 to 150,000 dato, the total emissions will be less, and the emission of sulfur dioxide, currently estimated at 1,270 dato, will be eliminated completely, as the Organocell process operates entirely without sulfur.

The load on the Danube from wastewater resulting from the still ongoing cellulose production using the old process was drastically reduced by the construction of a sewage clarification plant, which began operation in May

1990. Once the new plant begins operations using the Organocell process, it will not only meet the pollution burden limits established by environmental authorities, but in some cases will actually beat them.

### **Ruhr Pilot Project Aims at Reclamation of Polluted Land**

92WS0026 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 12 Sep 91 p 8

[Article by "re.": "Successful Attempt at Encapsulation of Groundwater Using Glass Retaining Wall; Pilot Project Awakens Hopes For New Prospects of Sanitizing Abandoned Pollution Sites— DM220 To DM300 Per Installed Square Meter"]

[Text] Soil and groundwater in the Federal Republic of Germany are being endangered by abandoned polluted areas and waste sites. Hopes that it may be possible within the foreseeable future to literally dam up these polluted areas have been raised by the successful completion in early 1991 of a pilot project in the Ruhr. Using the first retaining wall ever to be made of glass structural parts, a drinking water procurement area was successfully sealed off from its surroundings. It may be that, in the future, underground glass structures will be used to encapsulate many possible centers of pollution quickly, economically, and with a dependable degree of impermeability.

More than 48,000 areas of suspected abandoned pollution were recorded in the Federal Republic of Germany during 1988. Experts predict that the number of cases will increase to approximately 70,000 in the old German laender alone. Against this background, the encapsulation of polluted areas as an effective means of blocking possible contamination routes takes on particular importance.

One essential technical element of comprehensive encapsulation measures is a system of vertical retaining walls, which must have the following qualities:

- It must attain a high degree of impermeability against aqueous and gaseous media.
- It must be durably resistant against aggressive media.
- Its impermeability must be verifiable.

According to the Technical Academy, waste dump foundation sealing systems designed for refuse must currently achieve a permeability coefficient of  $K < 5 \times 10^{-10}$  meters per second (m/s). Logically, the encapsulation of abandoned polluted areas should be subject to corresponding requirements. The current state of the art in vertical encapsulation is a mineral retaining wall composed of synthetic retaining elements or steel sheet pilings, multi-layered where necessary. The use of a glass retaining wall to successfully encapsulate a reservoir of untreated water in February 1991 proved that glass structural parts are suitable, in principle, for use as subterranean retaining walls.

The impetus for this unprecedented project was provided by problems at a water procurement area in the Ruhr. To enrich the groundwater, the area was being irrigated with treated drinking water, which was then reextracted. To put a halt to a regular loss of water from drainage, the operators wanted to construct a 450 mm-long retaining wall to completely block off the groundwater stream. A team from Sheet Glass Consult GmbH in Gelsenkirchen and Philipp Holzmann AG was commissioned to solve the problem. The team proposed a startling concept, which had been worked out in the course of a research project: The customary steel sheet pilings would be replaced by U-beams made of alkaline lime glass.

During construction, a subterranean curtain up to 12 mm deep is excavated using a special clamshell bucket. During the excavation, the curtain is continually filled with a slowly hardening bentonite suspension. A steel guidance frame is then installed over the trench. Hanging from a boom, the glass elements are placed over this frame closely together in the subterranean curtain, so that the U-beams adjacent to the guide rails interlock. Guided by the frame, the glass plates slide on the already standing subterranean wall. This procedure is suitable for nearly any subsoil. The suspension stabilizes the subterranean curtain during excavation, cushions unwanted movement by the components as they are installed, and supports the glass plates once they are in place.

Using high-pressure pinpoint injection of water, the hardened suspension can be re-liquified. This is useful when the first shift of the day must connect the first element to the last element installed the previous day. A rinsing box ensures selective liquification of the bentonite.

The reliquification of the bentonite suspension is even more important when the glass beam adjacent to the locking seam is to be rinsed free. The locking seam, which is fixed precisely in place with high-density polyethylene sliding locks, is crucial to the contamination barrier. Consequently, after the suspension has been flushed, the seam is sealed with a metallo-organic silicate gel impermeable to most known contaminants. In this combination, the glass retaining wall has a system permeability of  $K_{fs} = 1.3 \times 10^{-13}$  m/s. Theoretically, this means that it would take a contaminant approximately 35,000 years to penetrate the barrier.

As a protective measure, there are wires running lengthwise through the glass elements. These are critical to important monitoring procedures carried out while the waste dump is in use. Because glass is an electrical nonconductor, the wires have a constant electrical resistance as long as they are completely isolated. Should one of the glass elements break, however, there would be an immediate, clearly measurable, change in resistance. The



optimum solution would be continual monitoring, whereby the wires would be permanently connected to automatic measurement systems. This method was not implemented in the Ruhr project, as it was not dangerous contaminants, but water, that was being dammed up.

Only two of approximately 900 glass U-beams broke during installation. The construction company workers were particularly impressed by this. Transportation problems were successfully solved before the end of construction via special packaging measures.

Incidentally, construction took place during extreme winter weather conditions. The sole problem: When rainwater froze, it broke off some elements that had just been installed immediately above the surface. This had no effect on the impermeability of the system, and was subsequently prevented by the application of a foil covering at night.

In the opinion of the initiators of the project, its successful completion represented an important step in proving the fundamental practicality of the concept. Now they are hoping to tackle a genuine abandoned pollution and waste encapsulation project. After all, at a cost of 220 to 300 German marks per installed square meter, it is not only the functionality and ecological compatibility of the glass retaining wall that is appealing, but its affordability as well.

Technical variations of the procedure, such as double- or multi-layer retaining walls, are possible, particularly where the reclamation of waste dumps is concerned. The gaps in such systems could be impinged by filling them with a gel which has an internal overpressure and is capable of swelling. This would prevent the escape of contaminants even in the case of an underground rupture in the retaining wall.

Dieter Kallinich, certified engineer and manager of Sheet Glass Consult, is of the opinion that, with some technical modifications, the procedure can theoretically be implemented to depths of up to 40 mm. However, the next important innovation will be a modification of the system's structural components. There are plans to increase the size of the retaining elements from 1.25 mm to 2.50 mm in the near future in order to reduce the number of interfaces in the retaining wall by up to 80 percent. A revised curve structure is also expected to afford the panels greater stability during installation.

## FACTORY AUTOMATION, ROBOTICS

### Germany: Computer-Operated Electron Beam Laser Developed

92WS0009B Duesseldorf VDI NACHRICHTEN  
in German 23 Aug 91 p 15

[Article by Norbert Schmidt: "EDP Stimulates Electron Beam Technology"; first two paragraphs are VDI NACHRICHTEN introduction]

[Text] Frankfurt, 23 Aug (VDI-N)—Use of the computer opens new areas of application for high-tech processes in manufacturing.

Barely established in manufacturing, the laser is already encountering competition: Computer-supported electron beam technology is dazzling with higher work speed and quality, particularly in welding and drilling.

The successful use of the high energy electron beam (EB) depends on the computer. Therefore, the experts at Messer Griesheim in Puchheim near Munich have designed a special controller based on a 32-bit processor. It permits monitoring of all parameters important to the results of the welding process, on-line determination of values exceeding tolerances, on-screen displays on the machine controller or the master computer, and plotter printouts.

The advantages of EB technology consist in that all important processing parameters are electrical values: "The EB machines use this physical process's advantage," stresses Dipl.-Eng. Peter Anderl, head of the electron beam technology division. "The results are defect-free products with quality certification." This is certainly an important advantage in the welding of the gas generator for the automobile airbag.

But electron beam technology also makes special demands: It can only be used in a vacuum. Because a vacuum is still the best "inert gas." This has led to the development of a new nitrogen-driven cryopump, which requires only one-third the time previously needed to create the vacuum.

"Naturally, that means three times the welding output in the same time," states Anderl with pride. Thus, it has been possible to achieve a significant step in the improvement of the manufacturing infrastructure in the area of peripherals. Because the welding speed of 60 mm/s with a weld depth of 4mm, as performed in the gas generator of the airbag, already represents noteworthy values. However, so far, at the maximum weld depth in steel of 200 mm, only a speed of 2 mm/s has been possible. Anderl stresses that due to the good control of the process and the documentation capability, the automobile industry is highly interested in this process. And with its financial strength, the purchase of an EB system, at a value between 1 and 6 million German marks [DM] would be a rather insignificant expense.

However, electron beam welding can excel not just in welding: In the drilling of a spinning head for glass wool production, EB technology was the clear winner over the laser. Because a spinning head has 11,766 holes, which an EB system produces in 40 min. "To obtain the same result with laser technology," calculates Anderl, "would require 20 solid-state lasers." With reduced thicknesses of materials, the EB machine obtained significantly higher performances: Currently, experiments are underway at Airbus Industrie for the reduction of micro-turbulence on the wings. Millions of extremely small holes in the surfaces should prevent the formation of

these eddies—an EB system is handling the production of these holes. A rate of 3,000 per second has been obtained—but that is only 60 percent of the physical limit of 5,000 holes per second.

But, despite these peak values, the laser is not being neglected as a second high tech pillar: "We do not want to pursue laser technology alone," states Dr. Ulf Benke, manager of the Frankfurt Department of Welding and Cutting Technology of Messer Griesheim. The company's goals are "rather to enter into reasonable cooperations in order to be able to act as a supplier of systems to solve problems." The joint venture with Eisenmann & Gissel in the area of robotics, the foundation of the Messer Lincoln GmbH in the U.S., and the cooperation agreement with MBB in Munich, which is to contribute its automation know-how, should be viewed in this light.

Benke believes additional concentrations are necessary, and he is working on the assumption that the company will add others in the coming years.

Much has already been accomplished technologically: "In the past, deep-drawn metal shaped parts in the auto industry were tooled primarily with milling machines, drills, keyhole saws, band saws, and sheet metal shears," according to the analysis of the level of development by Dr. Lothar Bakowsky of the Department of Laser Technology in Puchheim. "Nowadays 3-D laser cutting systems, which have revolutionized the construction of prototypes, are in use." Whereas here in Germany it is primarily automakers such as Audi, Ford, and VW who are using such systems, the supplier and purchaser market in Japan is significantly broader and differentiated, stresses Bakowsky.

Based the Japanese "market model," Messer Griesheim now wants to interest suppliers in tools made of light with small 3-D systems. "Therefore, beam guide machines are being produced in cost-effective steel-reinforced concrete construction and have teach-in programming technology, tailored to the skilled worker," concludes the laser expert.

#### **Netherlands: Application of CAD/CAM Systems Analyzed**

91AN0548 Rijswijk POLYTECHNISCH WEEKBLAD  
in Dutch 5 Sep 91 p 9

[Article by J. Bakker: "CAD/CAM Systems Increasingly Popular With Companies"]

[Text] The interest of Dutch industry in computer-aided design and manufacturing (CAD/CAM) has grown considerably.

A survey conducted by the Central Statistical Office (CBS) revealed that, in 1990, one out of three companies was using a computer for product design. This is an increase of 37 percent in comparison to the situation at the end of 1988. Throughout the 1988-1990 period, the

number of companies which installed computer-controlled manufacturing equipment increased by 25 percent.

However, it should be pointed out that the CBS has used very unusual survey methods to come to these figures. Indeed, it did not only take into account the actual number of CAD/CAM systems, but also the investment plans for the year 1990 of the companies surveyed. These figures are published during the second half of the year. If these investments were effectively made, there should be some 27,000 CAD systems operational throughout industry. This is an increase by as much as 62 percent in comparison to the situation at the end of 1988. One-half of these systems are PC-like machines; the other half involves more powerful machines (costing more than 25,000 guilders apiece) that are hooked up to a central computer. Some 36,000 people are currently assumed to be using CAD equipment.

#### **Production Disruption**

The companies themselves admit that they have, to a greater or lesser extent, given in to these new production methods. One out of three companies considers it impossible to return to conventional design methods; the remaining companies think it would lead to a waste of time.

Computer-aided production planning (CAPP) and materials requirement planning (MRP) systems were used by 10 percent of the companies at the end of 1988. It is likely that this number increased to 18 percent by the end of 1990.

The CBS survey focused on companies with more than five employees in the mining sector, in industry, and in the computer services and technical consultancy sectors. The construction and installation industries were also surveyed, except for companies with fewer than 20 employees. Computer dependence was found to differ strongly from sector to sector. Nearly 50 percent of the industrial companies said that a breakdown of computer-aided production planning would seriously, if not completely, disrupt production activities. In the construction industry, only 12 percent refer to this risk.

#### **On a Limited Scale**

Both the use of computer-aided design and computer-aided manufacturing is strongly dependent on the company size. The penetration rate in companies employing more than 100 people is almost double that of smaller companies. Apparently, computer-aided design is still an "isolated activity." Integration of the different design phases is still virtually nonexistent.

Although a majority of the companies acknowledges that it electronically transfers data from one design phase to another, two-thirds of that majority admit that this is done on a rather limited scale.

Almost half of the companies questioned electronically transmit the production data resulting from the design phase to the computer-controlled production equipment.

The number of computer-based production systems is growing less rapidly. The penetration rate amounts to 33 percent for CAD and to 26 percent for CAM. About one-fifth of the companies, especially the larger ones, think that switching back to conventional production methods has become impossible. Smaller companies think they can still do without computer systems.

## LASERS, SENSORS, OPTICS

### Infrared Free-Electron Laser Developed

91AN0547 Rijswijk POLYTECHNISCH WEEKBLAD  
in Dutch 5 Sep 91 p 3

[Article: "'Felix' Free-Electron Laser Produces First Infrared Beams"]

[Text] A team at the Institute for Plasmaphysics of the Institute for Basic Research Into Matter (FOM) has succeeded in producing infrared radiation using the "Felix" free-electron laser. The Netherlands is the first country in Europe to produce this kind of light using an operational free-electron laser. The infrared wavelength region in particular is of great significance for scientific research.

Construction of the 15-meter-long laser began in 1987 and has been extremely fast. Other countries such as Germany, France, and Italy, which are developing similar free-electron lasers, are envious that the Netherlands has succeeded in building a good operational laser in four years with the generous support of the Ministry of Education and Sciences.

This is the first free-electron laser that can produce radiation in the infrared region (8 to 80 microns). To date, free-electron lasers could only produce light in the visible spectrum or in the microwave region. Accurately tunable infrared light sources are virtually nonexistent at the moment, despite their significance for scientific research.

### Dumping

A special feature of a free-electron laser is that its wavelength is accurately tunable and fairly easy to change. Felix operates using an electron beam. First, the electrons are released from a cathode and subsequently fed into an electron accelerator, where they are excited to an energy level of 25 million electron volts. The electrons then traverse a magnetic field at nearly the speed of light. In this field, a series of small magnets are positioned one after another with opposite polarities, causing the electrons to undulate. At each undulation, the electrons produce radiation. The energy level determines the wavelength of the beam. By changing the intensity of the magnetic field, the wavelength can be adjusted quite easily and precisely.

This tunability of wavelengths now makes it possible, for example, to study information about various properties of atoms or molecules using only a single series of measurements, or to perform detailed observations of reaction processes in molecules as a function of time. To optimize Felix for applications other than in physics, it will be extended with a second beam operating at eight microns during the next year. Felix currently operates at a range of 17 to 80 microns.

## MICROELECTRONICS

### Philips Develops Dustfree Chip-Drying Process

91AN0542 Rijswijk POLYTECHNISCH WEEKBLAD  
in Dutch 29 Aug 91 p 4

[Article: "Marangoni Method Suitable for Dustfree Drying of Integrated Circuits"]

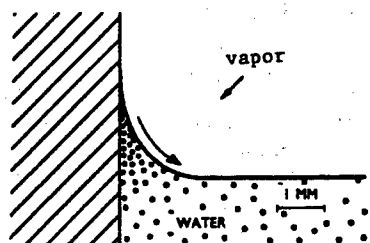
[Excerpts] Researchers at Philips' Natlab (Physics Laboratory) in Eindhoven have developed a new and clean process for drying silicon wafers. The method, known as Marangoni drying method, is also suitable for drying other materials used in the electronics industry. According to Philips, the new process is of great significance for the production of integrated circuits, where cleanliness requirements are becoming increasingly tighter. [passage omitted]

The Marangoni drying process is based on a phenomenon that was first described by the Italian physicist Marangoni. It is based on the principle that the surface tension gradient affects liquid flow along a surface.

### Meniscus

Natlab researchers applied this principle by blowing the vapor of a water-soluble organic compound (isopropyl alcohol) against the silicon wafer exactly at the location where it comes out of the rinsing bath. The vapor is absorbed by the water. As a result, the alcohol concentration is higher at the interface of the upper surface of the meniscus and the product surface than deeper down in the rinse liquid, where the dissolved alcohol vapor diffuses more easily into the water. This gives rise to a concentration gradient at the meniscus along with a surface tension gradient. The latter produces a Marangoni effect which causes the water to flow back into the bath.

After applying this process, the water film remaining on the product is only a few nanometers thick. Thus, at leaving the rinse bath, the product is virtually dry and clean.



Alcohol concentration gradient along the rinsing water meniscus at a surface which is lifted out of the water.

## TELECOMMUNICATIONS

### EC Commission Approves Competition Rules

92WS0051M Brussels EUROPE in English  
12 Sep 91 p 13

[Article: "(EU) EC/Telecom/Competition: The European Commission Publishes the Guidelines for Its Policy Concerning the Application of Competition Rules in the Telecommunications Sector"]

[Text] Brussels, 11/09/1991 (AGENCE EUROPE)—As announced, the European Commission has approved and published in the Official Journal (n.C/233 of 6 September) a long detailed communication giving the "guidelines on the application of EEC competition rules in the telecommunications sector".

The text is for the attention of operators in this sector so that they might know what is legal and what is not legal in their agreements and in their behaviour in general. The Commission objective is the development of efficient Europe-wide networks and services, at the lowest cost and of the highest quality, to provide the European user in the single market of 1992 with a basic infrastructure for efficient operation. The Commission reaffirms that liberalisation (to intensify competition) and harmonisation (to guarantee the network's uniformity and interconnectivity) must go hand in hand. Telecommunications operators must be allowed, and encouraged, to establish the necessary cooperation mechanisms, in order to create—or ensure—Community-wide full interconnectivity between public networks. This, however, must be done in compliance with competition rules and avoiding abuse on the part of those holding a dominant market position.

In the light of this objective, the Commission document specifies the forms of cooperation allowed or prohibited, from experience gained in different affairs in compliance with the Court of Justice decrees. Nevertheless, the Commission underlines that "these guidelines do not create enforceable rights" (point 10). The Commission firstly underlines that the competition rules (articles 85 and 86 EEC) apply to the ONP—Open Network Provision, and give the conditions of application of article 90, par. 2 (which justifies certain competition restrictions

which may be imposed by States and not by enterprises). The Commission then gives its guidelines concerning the definition of the "relevant market".

The main part of the communication concerns the application of article 85 in the telecommunications sector (ban on agreements) and of article 86 (banning abuse of dominant positions). The Commission reviews the different categories of agreement: on the supply of installations, on prices, on technical norms and on the provision of services, relating to research and development, etc. It defines the notion and the conditions of abuse, recalling the cases where it has already had to intervene and the principles followed (for example, in the case of IBM).

The last parts of the communication concern the restructuring of telecommunications (notably deregulation and mergers between enterprises and the impact of international conventions — ITU [International Telecommunications Union], CAMTT [Telephone and Telegraph Administrations], CCITT [International Telephone and Telegraph Consultative Committee]).

The Commission reserves the possibility to modify the guidelines in the event of fundamental or repeated changes in the legal precedents or the regulatory, economic and technical context (point 11).

### Europe's First Frame-Relay Service Launched

92WS0051P Chichester INTERNATIONAL  
TELECOMMUNICATIONS INTELLIGENCE  
in English 2 Sep 91 pp 1, 3

[Article: "Europe's First Public Frame-Relay Service"]

[Text] StrataCom, Digital Equipment Corporation and Telecom Finland are claiming to have launched Europe's first frame-relay service. The service, which provides subscribers with frame-relay access speeds of between 64Kbit/s and 1Mbit/s initially, became available on August 19th.

Telecom Finland views the introduction of the service as a means of providing subscribers with virtual private networks, according to Frame-Relay Manager, Juha Heinanen. Access at 2Mbit/s will be available by the end of this year. A spokesman described the service as a "part public, part managed network, a bit of both, a sort of virtual private network."

StrataCom says that the introduction of the new service is an extension of Telecom Finland's LAN [local area network] interconnection service, DataNet, which was introduced during 1989 and which is based around CISCO [Compass Integrated System Compiler] Systems router technology for both the network backbone and CPE. This first service is a multi-protocol TCP/IP [Transmission Control Protocol/Internet Protocol] based routing network.

The frame-relay enhanced DataNet network is being implemented using five StrataCom IPX fast packet

switches, each of which can host up to 120 frame-relay ports. StrataCom will supply, through DEC, its worldwide marketing partner, a number of additional IPX systems later this year.

Telecom Finland says that while voice transmission is technically feasible over the frame-relay network at present, it is not part of the current customer offering and "plans in this area are still open". If voice services are to be offered to customers in the future, Telecom Finland says, the frame-relay service will most definitely be separate from its ISDN service.

Data access by customers is at Layer 2 of the OSI [Open Systems Interconnection] reference model, allowing any network layer protocols or bridging to interconnect LANs to be used. Other equipment, such as X.25 switches and SNA communications controllers can be connected over the frame-relay backbone, CISCO Systems' routers have undergone considerable software development to enable them to interwork with the frame-relay service. CISCO said that the use of its frame-relay enhanced routers in the network will bring "the benefits of added performance to users of cisco-supported protocols over frame-relay, including TCP/IP, DECnet, OSI, Apple Talk and Novell IPX."

CISCO routers are the most common CPE [central processing element] among DataNet's estimated 200 users and can now be software-upgraded to operate in the new frame-relay project at Telecom Finland.

Under the DataNet service, Telecom Finland provides customers with the design, implementation and management of his/her network. The DataNet networks are managed seven-days-a-week and 24-hours-a-day, using SNMP-based network management centralised in Tampere. Customer networks can be controlled to customer router level or even beyond to the customer LAN.

With the router DataNet networks, customer network speed varies from 19.2Kbit/s to 100Mbit/s. The networks support TCP/IP, DECnet and ISO/IP. IBM connectivity is provided by Source Route Bridging of Token Ring LANs. International interconnection of LANs is via the InfoLAN service operated by Infonet, which worked closely with Telecom Finland during the development of InfoLAN.

Telecom Finland is also experimenting with high-speed LAN interconnection using Metropolitan Area Network technology from Alcatel SEP [European Propellent Company], the Finnish subsidiary of the French company which has taken worldwide marketing rights to technology originally developed by Telecom Australia subsidiary, QPSX Communications.

Telecom Finland says that it sees the Distributed Queue Dual Bus/MAN technology as an efficient way to offer switched services of LAN interconnection in metropolitan areas in a way that makes it possible to use the fibre-optic network efficiently—compared with frame-relay, "we see DQDB as a more fibre-oriented technology."

Additionally, Telecom Finland sees frame-relay as more practical for long-distance connections than DQDB at present and it expects 34Mbit/s interfaces to become available for frame-relay soon. It says it is aware of laboratory prototypes with still higher speeds, indicating that transmission speed would not be a factor to differentiate DQDB and frame-relay. Cost is today the most important factor when evaluating the different technologies and there frame-relay has a clear advantage.

MAN [metropolitan area network] type services, such as the interconnection of FDDI networks, are being offered as part of the normal DataNet services. Telecom Finland says that it is still waiting for DQDB products to reach full technical maturity and reasonable level of costs and that it will introduce DQDB-based products into its network when these costs are fulfilled. "We are continuing to co-operate with the leading vendors on these matters," the company said.

### Cost of EC's HDTV Proposal Criticized

*91WS0539H Brussels EUROPE in English  
31 Aug 91 p 7*

[Article: "(EU) EC/Audiovisual: Publication of a Report Critical of the Commission's HDTV Project"]

[Text] Brussels, 30/08/1991 (AGENCE EUROPE)—According to a report by a firm of British consultants, the Directive on the High Definition Television (HDTV) recently proposed by the European Commission, if adopted, could cost between 12 and 21 billion European currency units [ECU] to the consumers, cable and satellite operators and the Community by the year 2001, notably due to the increased costs of televisions, the adaptation of the equipment and concomitant Community subsidies. This study, financed by a group of European broadcasters (notably the Societe Europeenne des Satellites, the International Filmnet Group and the VPRT federation representing private German channels), is a criticism of the Commission's project aimed at promoting, for an interim period starting in 1993, the use of D2-MAC standard of transmission by satellite before the introduction of the European HD-MAC standard.

Among the added costs mentioned in the report, the consultants foresee, notably, an increase in the order of ECU100 to ECU200 for the purchase of a large screen (over 52 cm) as well as certain investments (between ECU80 and ECU400 per household subscribing) aimed at permitting the tele-distributors to broadcast in future both under traditional standards and those recommended by the Commission. But, the experts further stress, only a very small percentage of European spectators will, in 1995, be in a position to take full advantage of HDTV. The solution proposed, even if only interim, does not therefore seem to be the right path to follow

towards HDTV and the report recommends that the choice of the HDTV system be left to the market.

This criticism comes just a few days before discussions start again in view to finding an agreement between broadcasters, satellite operators and electronic companies to support the Commission's project.

#### **PAL-Plus 16:9 Television Standard Due in 1995**

91WS0549A Paris AFP SCIENCES in French  
5 Sep 91 p 15

[Article: "Television: PAL-Plus To Replace PAL for Terrestrial Broadcasting?"]

[Text] Berlin—In addition to HD-Mac, which is to become the new European standard for high-definition television [HDTV] via satellite broadcasting, there is also a replacement standard for terrestrial broadcasting: PAL- [Phase Alternation Line] Plus, which offers high-quality broadcasts in the 16:9 "cinema" format.

Four television manufacturers—Philips, Grundig, Thomson and Nokia—have been working since 1988 on this new standard, which has the advantage of being compatible with PAL, the standard most utilized today.

At the Internationale Funkausstellung, the big consumer electronics exhibition now under way in Berlin, the principal television makers are reluctant to discuss the difference PAL-Plus will make in terms of improving the quality of television images.

But work on development of the new standard continues. Its technical criteria should be finalized in 1993, and broadcasting of programs in PAL-Plus is expected to begin in 1995. Some pilot programs are already being shown to Berliners at one of the smaller exhibition stands.

Officially, the manufacturers deny PAL-Plus is trying to steal the limelight from the D2-Mac [Definition 2 Multiplexed Analog Component] compatible televisions that were introduced with great pomp at the exhibition as the intermediate standard that is supposed to ensure a smooth transition to HD-Mac [High-Definition Multiplexed Analog Component].

France's Thomson and Germany's Grundig even say they see PAL-Plus as a "necessary complement" to D2-Mac and later HD-Mac, since it will stimulate sales of television sets and production equipment for the 16:9 format without hurting the television stations, most of which use terrestrial transmitters. So why are they so reluctant to talk?

Grundig's CEO [chief executive officer], Mr. Johann van Tilburg, gave the answer himself: It is a question of not further confusing the public, which is already somewhat perturbed by the complicated debate, in Brussels, between the TV manufacturers and TV stations over how to popularize D2-Mac programming.

The current draft European directive, still quite controversial, would require television stations that broadcast via satellite to offer their new programs in both D2-Mac and PAL formats. For the manufacturers, such a directive would mean rapid popularization of D2-Mac and technological dominance in a highly competitive market.

But for the television stations, the requirement to produce new programs in D2-Mac would impose heavy costs at a time when economic conditions are poor and they have already made substantial investments in the last few years to convert to PAL-format satellite broadcasting.

#### **France: LETI Pursuing Micropoint TV Technology**

92WS0002C Paris AFP SCIENCES in French  
12 Sep 91 pp 19, 20

[Article: "The French in the Race to Flat-Panel Displays With Micropoint Technology"]

[Text] Grenoble—On 23 August, in Japan, when Grenoble researchers publicly introduced a flat-panel TV screen measuring 10 by 12 cm, weighing 100 grams and having a thickness of 2 mm, they showed that they were full-fledged contenders in the race among large countries to offer to the public the television of tomorrow, which will hang from a wall like a picture. Three technologies are currently competing to create and industrialize this television of tomorrow:

- Liquid crystals (like those of digital watches), the technology with the largest research budgets, especially in Japan; but these displays are difficult and costly to make. They do not like temperature changes and have a slow response time.
- Plasma displays: their colors are not very bright and their service life is short.
- Micropoint displays: a technology under development which, according to the Grenoble researchers, needs three more years of research, but would be less costly and more reliable than the other two.

It was in 1983 that a researcher at the Laboratory for Electronics and Data Processing Technologies (LETI) of the Atomic Energy Commission (CEA), Mr. Robert Meyer, became interested in the American micropoint technology designed by Capp Spindt under a space and defense research program.

It was the LETI, however, that had the idea of using this electron source to manufacture a flat-panel display where millions of guns (the micropoints) fire electrons at a glass plate covered with a film of phosphorus, which forms the display. This technology is very close to that of integrated circuits. Twelve patent applications have been filed, but the display colors still have to be improved and its size increased.

The French company Thomson financed the project from 1988 to 1990, with 20 or so LETI researchers, but although it acknowledged that the technology is very interesting, it gave up for lack of means.

Since then, the project leader at the LETI, Mr. Jacques Duchene, has been looking for some 100 million French francs to finalize the development of the display. "It's a huge wager, but if we can develop the process and its industrialization, we can totally revolutionize the world of flat-panel displays for television and portable computers. This technology may be as good as gold."

He made the round of manufacturers worldwide, and the Japanese are among the candidates. "No researcher in a French public laboratory wishes to see his work leave for Japan, and the Ministry of Research would probably say no. But as the Japanese remain the best for industrialization, we can try to set up a partnership with them, with (why not?) a factory in France," he added.

### France: Mobile Telephone Services Expanding

92WS0038A Paris MESSAGES in French  
Sep 91 pp 30-35

[Article by Anna Heym: "The Boom in Mobile Telephones"; first paragraph is MESSAGES introduction]

[Text] Planes, high-speed trains, trucks, cars, or...two-legged locomotion: None of these modes of transportation are now beyond the reach of mobile-telephone communication networks. The latest offspring are the Aircom satellite and TFTS [Terrestrial Flight Telephone System] in the air, and GSM and Pointel down at the farm. It is a booming market, that should comprise some 20 million subscribers by the turn of the century.

"Hello, Captain Kirk, do you read me? - Yes, Mr. Spock, go ahead."

Starting this fall, the small pocket telephones used in futuristic series such as Star Trek will graduate from the realm of science fiction into our everyday lives. That is when Pointel, a terminal weighing less than 200 grams manufactured by Sagem, Matra, and Dassault and developed by France Telecom, will begin experimental use. Also in a few months, the first planes equipped with public telephones will take off from French airports.

The communications market for people in transit should grow at an extremely rapid pace between now and the year 2000. It is already predicted that in 1995 mobile telephones will account for five percent of France Telecom's sales, or five billion French francs [Fr]. That is five times more than in 1989. The public company's goal is to become one of the world's top carriers in mobile communications. To achieve it, France Telecom plans to invest Fr2 to 2.5 billion each year in the sector.

1991 thus marks the start of a new policy. It is also the year of highly novel mobile products, and coincides with preparations for the World Radio Communications

Administrative Conference. This international meeting will be held in Spain next February and will establish the broad lines of development of future mobile communications services—starting with the on-board airplane telephones experimentally operated this year in France.

Indeed, last 12 June, the first French telephone connection linking an airplane—a Falcon 900—to the Earth was made above the Bourget landing strips. In just over a year, any passenger will be able to make a call from an airplane flying Europe's skies for Fr35 a minute, or send faxes or data to any part of the globe. It is potentially a very lucrative market since, of the 190 million passengers who board international or domestic flights each year in Europe, 12 percent state that they would "certainly" make a telephone call during their trip, and 27.8 percent would "probably" do so.

"This service already exists on certain lines flying the American continent," explains Michel Bertinetto, director of the mobile communications division of France Telecom. "But tomorrow, thanks to digital technology, very high-quality service will be available all over the globe."

To cover the entire air space, two systems will coexist. The first, Aircom satellite, will use Inmarsat satellites, which make up four groups of stations above the Earth. The plane will be equipped with a specific antenna that will send a radio signal to one of the satellites. The communication will then be bounced back to an earth station, which will connect the airplane with the telephone network subscriber.

### The Agreement of Countries Being Overflown

The system will be geared to the communication needs of intercontinental flight passengers flying over sparsely populated territories, such as the oceans. It will be operational this year and come into general use starting in 1992. Passengers will be able to make calls but not receive them. The service will cost them about Fr60 a minute.

On 31 May, 1989, France Telecom signed an agreement to form a consortium to offer full-globe service, in partnership with the International Aeronautic Telecommunications Company (IATC) and two other carriers, Teleglobe (Canada) and OTC (Australia).

The second system is called TFTS. It was developed by France Telecom, in conjunction with other European partners. TFTS is tailored to the communications needs of passengers on continental flights traveling above densely populated areas, such as Europe. The link is established directly with the Earth, then the call is transmitted through a system of transceivers, or cellular equipment, that relay it. When the plane flies beyond the reach of one cell, it is automatically connected with the neighboring one. It is the same principle that is used in the high-speed train (see page 34) or Radiocom 2000 telephones. In France, for example, it will require eight



to 10 transceivers, each covering a radius of 250 kilometers. A minute of call time will cost less than it does via satellite: only Fr30 to Fr40. The project will be operational in 1992 and the TFTS will be available on planes the following year.

In the beginning there were a few problems to be ironed out: It was necessary, for instance, to get the public service companies of the principal countries overflown to agree to the TFTS. An agreement was reached in November, 1990 between France Telecom and nine European countries, and completed last November with the signing of an MOU (memorandum of understanding) with all the European carriers concerned and with IATC.

#### **"The GSM Is Our Sheet Anchor"**

The chief problem today is different in nature: "On-board equipment has not yet been standardized," explains Michel Bertinetto. "In contrast to the United States, our planes will not be equipped with a simple booth or with a terminal brought to the caller by the crew. Service will be seatside. We will install handsets by groups of seats. We still need to find equipment that is suited to both Aircom and TFTS; it will also have to meet the standards of Civil Aviation. Moreover, airlines remain in control of their airliner equipment plans." But there is no cause for concern: the "bulk of the work" is done. All that is left is to smooth out the details, before the upcoming inauguration of the two on-board telecommunications services.

This breath of novelty also depends on improving existing products, starting with radiotelephones, more commonly known as car phones. With GSM, the first pan-European digital radiophone, France Telecom is already preparing for the post-1992 period. "We are seeing a growing awareness of the market potential," explains Michel Bertinetto. "For a long time radiotelephones were seen as outward signs of success, good for enhancing one's image. Today they are becoming work tools. This change has prompted an increase in demand and greater diversity in customer expectations."

The success of the radiotelephone offered by France Telecom—230,000 subscribers at the end of 1990, accounting for 80 percent of total mobile phone sales—has even raised a few problems. Marketing of national subscriptions to Radiocom 2000 had to be suspended in July of 1988, to preserve service quality. Indeed, the Hertzian frequencies allocated to mobile phone services are rare commodities, especially as television and the armed forces take up three-quarters of the "spectrum." However, marketing of the service began again 1 July, 1991.

"Due to lack of space on the spectrum, it is impossible to expand the analog network," Michel Bertinetto goes on to say. "That is why our offer of radiotelephone service has fallen a bit behind. We have an equipment stock of 5 mobiles per one thousand inhabitants. England has five times as much. In Scandinavian countries, the amount is multiplied by ten. With Radiocom 2000, we have an

upper limit of 40,000 subscribers." To the latter must be added the 65,000 French subscribers of the SFR, the second-largest national analog radiotelephone network. It was launched in March 1989 and is currently booming.

"As long as we operate on Radiocom 2000, we will have to use expedients. The GSM is our sheet anchor," continues the director of the mobile communications division. "We are going to open an experimental network starting this year, and will market it in the following six months. This new radiotelephone system will ultimately allow us to satisfy four billion subscribers in France and 20 million in Europe."

#### **Digital Technology**

How does the GSM compare to Radiocom 2000? The new car phone is European, not simply French. Indeed, 17 countries have adopted common standards, enabling subscribers to call from practically anywhere in Europe, whereas analog systems are mutually incompatible.

The GSM also foreshadows the use of digital technology in mobile telephone communication. The quality of the new car phone will be excellent, and the endless repetitions of "Radiocom 2000... We are searching your correspondent..." will be eliminated. Moreover, the digital system will make it possible to adapt new services for use in car phones, such as call transfers, signaling of a call on hand, or three-way conferencing. Other services being proposed include data transmission, faxing, and message systems. It will thus be possible to transform vehicles into real traveling offices.

The commercial inauguration of the Paris and Lyon networks has been set for mid-1992. It is a crucial date for France Telecom, but also for SFR, the second French telephone company chosen to develop the new network. Starting in 1993, the GSM should serve the largest urban centers, and in 1995, 70 percent of the population. Michel Bertinetto predicts that Radiocom 2000 will gradually be replaced over the next 10 years. "However, we will maintain the company network system, which currently allows 50,000 subscribers to communicate via radiotelephone inside their companies."

#### **At Home Or On the Job**

But the future of mobile communications does not concern transportation alone. It also directly affects the individual, starting with the pedestrian. With Pointel, the first personal pocket telephone, which will be used experimentally in Strasbourg starting in September, calling from a cafe terrace or public place will be child's play. A small terminal weighing about 200 grams and barely larger than a pack of cigarettes will allow users to stay in touch with the entire world!

A system of public terminals—350 will be installed in the Alsatian town—will relay the call to the exchange serving the party called. "With Pointel, we are aiming at a market different from the radiotelephone one," Michel Bertinetto continues. "We can post lower prices from the



outset. The terminal will cost about Fr2,000 when first marketed, versus the Fr15,000 for a radiotelephone, and the amount should drop as the customer base rises. The subscription price will be approximately the same as for classic telephone service. Only the cost of the call will be a bit higher."

Two costly functions have been eliminated in order to make Pointel profitable. The first one is "hand-over", that is, automatic intercellular transfer, used in car phones for example. It allows a mobile phone in transit to move from one terminal to another without being cut off. Another function eliminated is mobile phone localization. In other words, the subscriber will theoretically not be able to receive calls.

Yet Michel Bertinetto firmly insists on one point: "We do not consider Pointel the poor man's radiophone! It is simply the first step toward a personal telephone service that will be usable in all the configurations." Indeed, Pointel will be able to function in the home, like a cordless telephone, and even at work, thanks to specific company PABX's (private exchanges). Moreover, France Telecom has planned terminals that will contain an Alphapage pager. They will be marketed in December, and will allow Pointel users to be paged (read page 32) and thus return their party's call. "In addition," says Michel Bertinetto, "it will be possible to receive calls as on an ordinary phone either at home or at work."

Personal pocket telephones will be extended to Paris in September of 1992—1,500 terminals will be installed in the capital—then gradually to all towns of over 80,000 inhabitants. France Telecom is counting on a huge market: 500,000 subscribers in 1995, then several million at the turn of the century.

### **First East-West Fiber-Optic Link Approved**

92WS0051R Chichester *INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE*  
in *English* 16 Sep 91 pp 1, 3

[Article: "Denmark To Install First East-West Fibre-Optic Cable Link"]

[Text] The Ministries of Posts and Telecommunications (MPT) of the Soviet Union and the Russian Republic have given their approval for the first fibre-optic cable to be laid between the USSR and the West.

Telecom Denmark and GN Great Nordic are to share the 500 million Danish krone [DKr] investment in the 565Mbit/s link to be built between Copenhagen in Denmark and Kingisepp, near St. Petersburg (Leningrad). It will have a length of approximately 1,260km and include 11 submerged regenerators. The cable will be supplied by STC Submarine Systems of the UK under a contract worth US\$65 million.

The system's capacity will be 16,000 circuits which will be used for telephone, fax, data and video transmissions between the USSR and Denmark. From Denmark traffic

will be carried to other countries via Telecom Denmark's international channels. Within the USSR, traffic will be carried via microwave systems to St. Petersburg and Moscow, respectively. Cocom, which controls the export of high-tech goods with possible military application to Eastern Bloc countries, has so far prevented the extension of the cable from St. Petersburg to Moscow.

Telecom Denmark and GN Great Nordic said their investment in the project will be returned from traffic fees after the link is put into operation in mid-1993.

Thomas Duer, GN Great Nordic's Managing Director, said he was confident that the current Soviet upheaval will not affect the project and that both ministries want to see the project completed as planned.

The Danish team said the cable they will be installing is the first part of the planned Trans-Soviet Line — a cable which will stretch across Siberia to link Europe with Japan and Korea. They also said that a second major link, from Moscow via Sevastopol, in the Crimea, to Italy is also under discussion.

At the end of last year, Alcatel of France insisted that it had been awarded the contract to supply the first section of the T-S-L project. Under this contract, Alcatel will lay 250km of cable between the cities of Irkutsk and Ulan-Ude, just north of the USSR's southern border with Mongolia (see *ITI* issue 274).

### **Germany, East Europe Plan Joint Fiber-Optic Network**

91MI0569 Coburg *OPTOELEKTRONIK MAGAZIN*  
in *German* Aug 91 p 188

[Text] The telecommunications companies of Poland, Czechoslovakia, Hungary, and the Federal Republic of Germany are planning a joint optical fiber network. Deutsche Bundespost Telekom (DBT) hosted a conference in Bonn on 18 and 19 December 1990, at which a joint declaration of intent on its implementation was signed. All the parties involved expressed their great common interest in close cooperation in this sector.

The project is called the Trans-Europe-Line (TEL) and, starting from Frankfurt/Main, will pass through the south of the former GDR to Warsaw, branching off at Gorlitz via Prague and Bratislava to Budapest.

The TEL project will substantially improve the telecommunications infrastructure between eastern and western Europe, and is essential to the economic development of the countries concerned.

The optical fiber network initiated by TELEKOM will be able to transmit simultaneously several tens of thousands of telephone conversations or their equivalent in data flows. It is hoped to extend the Frankfurt/Main to Warsaw link as far as Moscow, and discussions to this effect are already under way.

The total length of the TEL cable line, including the Moscow link, will amount to some 3,200 km, and the overall investment for the TEL project is estimated at around 200 million German marks. It is scheduled for completion by the end of 1993.

### **German Telecommunications Minister Discusses European R&D Trends**

91MI0568 Coburg OPTOELEKTRONIK MAGAZIN  
in German Aug 91 pp 186-187

[Text] "To ensure and enhance economic efficiency, postal and telecommunications regulation policy will receive more attention worldwide than has been the case until now. The reasons lie in the technological and ecological development of all industrialized countries," stated Dr. Christian Schwarz-Schilling, Federal Minister of Posts and Telecommunications, in his address to the Third International Conference on Telecommunications Policy and Regulation in Berlin.

"Telecommunications is a major economic factor within the European Community. By the year 2000, about 1,000 billion German marks [DM] will have been invested in telecommunications in the European Community, and the competitiveness of over 60 million jobs in the EC will depend to a greater or lesser degree on telecommunications and information technology." This was how Schwarz-Schilling described the major role of telecommunications in the liberalization of the movement of goods, capital, and services in Europe, adding that the regulation and competition policy frameworks required for this development were already largely in place.

"Monopolies will be allowed for the network infrastructure and the telephone service only. For data transmission, meaning transfer services only, all other telecommunications services performed via terrestrial networks, and all telecommunications terminal equipment, competition is in order. Satellite and mobile communications will be covered by a separate EC regulation. These regulations on competition also apply to public telecommunication companies. German regulatory policies on telecommunications are fully in line with the framework laid down by EC law, and in fact they are more liberal in certain areas," Schwarz-Schilling added.

Increased competition required technological compatibility, however. For this reason, the EC was pressing for Europe-wide harmonization, especially in new network technologies and services. The minister cited the examples of Euro-ISDN [Integrated Services Digital Network], the European mobile radio standard GSM—better known in Germany as "D-Netz"—and the European radio paging system ERMES; over 20 European countries were involved in all three projects.

"Back in July 1989, we ushered in a new era for Germany when the law that restructured the postal service came into force," added Schwarz-Schilling, who defined the basic principle of the reform as follows:

"Competition is the rule, whereas monopoly is the exception and has to be justified."

This meant that all telecommunication services and terminal equipment had to be offered competitively, the sole areas not open to competition being, for reasons of infrastructure, the telephone service and transmission paths. Competition was also permissible, however, in the fringe areas of these remaining monopolies. Schwarz-Schilling mentioned satellites and mobile radio communications as the major sectors.

He went on to say that a further cornerstone of the reform was the separation between responsibility for national policy, sovereignty, which was in the hands of the Ministry of Posts, and the operational and commercial aspects, which had been taken over by the three companies making up the German Bundespost. Postal reform had created numerous new areas of responsibility for the Ministry of Posts in its new form; for example, as Bundespost Telekom provided services in both the monopoly and the competitive area, the Minister of Posts had to ensure, in compliance with government policy, that competitors were able to bid for Bundespost Telekom's monopoly services on fair terms. "In future it will come down to striking a balance between infrastructure and competition," said Schwarz-Schilling.

The granting of licenses for the digital D2 network for mobile radio, trunk radio, and for setting up private satellite networks has shown how quickly the new competitive scenario has taken shape and been accepted. So far, 14 licenses have been granted to private satellite operators, including four to foreign companies," said Schwarz-Schilling, adding: "Satellite communications are of exceptional importance in improving communication links between the older and the new laender. Therefore, owing to the to.MDBO/t.MDNM/ally inadequate earth-bound facilities in the new laender, private network operators have been licensed to offer a telephone service by satellite. Eight firms have so far been granted permits." Licensees can supply telephone services in, to, and from the new laender until 31 December 1997, with the option to link their satellite networks to the Bundespost's public telephone network.

### **Philips Acquires Telecommunications Contracts**

92WS0051Q Chichester INTERNATIONAL  
TELECOMMUNICATIONS INTELLIGENCE  
in English 9 Sep 91 p 3

[Article: "Three Contract Awards for Philips"]

[Text] Philips' Public Communication Systems Division in Nurnberg, Germany has recently been successful on home ground with the award of three contracts, two of them from Deutsche Bundespost Telekom (DBT).

The first DBT contract, worth an undisclosed nine-figure sum, is for the delivery of tss digital switching systems to provide Automatic Call Distribution (ACD) facilities.

Under the contract, Philips will install over 200 operator services systems for ACD in the Telekom service, known internally as PLA-TS. With ACD, the calls arriving via special service numbers are automatically transferred to the next free operator position of the corresponding service group.

The ACD system will also be used for internal communication within the Telekom service and enables, via the public network, access to and from private automatic branch exchanges.

Philips is also supplying 150 ISDN videophones to DBT for its videophone service, expected to be launched this Autumn. Philips' 'Teleview' ISDN videophones can be used with ISDN basic rate access and ISDN [Integrated Services Digital Network] private automatic branch exchanges (PABXs). In the same way as the ISDN telephone, the Philips videophone has a standardised interface and operates with a transmission rate reduced to 64Kbit/s for the full-motion colour picture and a further 64Kbit/s for speech transmission. In another version for in-house applications, 112Kbit/s are used for video transmission and 16Kbit/s for speech transmission.

Awarded by Vogelsberg GmbH, the third contract involves the installation of a transmission link to monitor systems at the Vogelsberg wind energy farm. The 2Mbit/s transmission system will link Lissberg and Crainfeld, via Gedern, Ober-Seemen and Hartmannshain.

The farm comprises nine wind power systems connected to the network control centre in Friedberg via a digital multiplex transmission unit from Philips. The Time Division Multiplex (TDM) system, PCM30P, and the drop/insert and cross-connect system, DICC2, have been installed.

#### **Philips' HDTV Developments Presented**

92WS0051N Chichester INTERNATIONAL  
TELECOMMUNICATIONS INTELLIGENCE  
in English 16 Sep 91 p 4

[Article: "Philips' HDTV/SDH Developments"]

[Text] Philips has announced a system for the transmission of HDTV [high-definition television] and a new SDH [synchronous digital hierarchy] compatible digital system for transmission of TV, audio and data transmission at 140Mbit/s.

Philips' system for the transmission of TV and video programmes using the new HDTV standard is based on the new HD MAC [High-Definition Multiplexed Analog Component] transmission standard.

Philips recently demonstrated HD MAC transmission via 140Mbit/s using its encoding procedure at the International Audio and Video Fair in Berlin.

Philips' encoding and transmission technology can also be used to convert HDTV signals for digital transmission in existing telecommunications networks via 140Mbit/s

channels. After the 140Mbit/s signals have been decoded on the receive side, the picture appears on the HDTV screen.

This means that digital signals can be transmitted from the TV station via cables or satellites to the TV receiver. The digital-to-analogue conversions, which reduce the transmission quality, become superfluous. The Broadband Distribution Network BK450 from Philips makes it possible to transmit HD MAC signals directly to the cable TV subscribers via BK distribution networks.

Philips' new SDH compatible DIMOS TV transmission system transmits TV channels in studio quality on network level 1. This includes the exchange of programmes between different TV broadcasting authorities and between TV studio and transmitter. In combination with the synchronous digital transmission technology, DIMOS can be used for feeding signals to the broadband distribution networks at the highest distributor level. With the DIMOS transmission system, PAL, NTSC, SECAM or HD MAC standard TV programmes can be transmitted. Signals with a bandwidth of 10Hz to 8.4Mhz, via an analogue input—and YUV signals, via a digital input—can also be transmitted. Additionally, DIMOS offers four audio channels with a bandwidth of 40Hz to 15KHz, four 64Kbit/s data channels and up to three 2,048Kbit/s data channels.

The digital signals are transmitted at a total bit rate of 139,264Mbit/s on copper coaxial cables or fibre-optic cables. The maximum range of transmission without repeaters is approximately 60km, enabling it to be used in long-distance networks.

#### **Dutch Videotex Use Increases Rapidly**

91AN0550 Amsterdam COMPUTABLE in Dutch  
23 Aug 91 p 1

[Article: "Use of Videotex Grows Considerably"]

[Text] The Hague—It is clear that electronic information services are now also gaining ground in the Netherlands. This is particularly true for services offered through the videotex system. The prerequisites for a successful introduction of videotex have considerably improved in both the business and private markets.

These optimistic comments were published in the report "Videotex Services in the Netherlands," drawn up by the Ministry of Economic Affairs. After the very difficult start of the PTT's [Post, Telegraph, and Telecommunications] viewdata system (Viditel) and failures such as the Ditzitel project of the Associated Dutch Publishers (VNU), it seems that videotex is finally growing to maturity.

An incentive project, known as "Business Market Information Brokerages" (IZM), has recently been started. It

involves the creation of a kind of electronic bookshop with a view to increasing effective demand for databases and improving the accessibility of relevant information sources to small and medium-sized companies. IZM, which operates as an independent marketing organization, is to explore the information requirements per line of business or per sector. In addition, IZM must be able to supply the completest possible information through the use of existing databases.

Furthermore, Economic Affairs contributes 1.5 million guilders to the "National Government Videotex Services Platform." This project, which also involves the Ministry of Interior Affairs and the Government Information Service, seeks to foster the use of videotex services within the Government.

The report expresses its satisfaction with the fact that a successful start was made with a nationwide network service (Videotex Netherlands), which is believed to be capable of conquering the consumer market and of further developing the business market.

Concurrently, the number of videotex applications in small and medium-sized companies is growing, thus increasing the functionality and, consequently, the

added value of the system. This evolution is due partly to the Ministry of Economic Affairs' incentives policy to stimulate demand for videotex services.

As already mentioned, the prerequisites for a breakthrough of videotex are much better than 10 years ago. The example of France has shown that a breakthrough is possible. Acquaintance with computer equipment has become a widespread phenomenon and electronic data processing and transfer are now commonplace, even in households. In addition, the number of genuine services is continuously growing, and companies are becoming increasingly aware that electronic communication has become a vital strategic option. The national government, too, could become a very big supplier and user of electronic information. However, a major obstacle to the development of videotex services is their low profit margins. The PTT has stipulated that information suppliers can make no more than 23.5 cents per minute of connection time. This is much less than in any other European country, where fixed network user rates vary from 73 cents to 8.41 guilders a minute. The fees paid by the Dutch PTT to services suppliers are among the lowest in the world.

## BIOTECHNOLOGY

### Hungary: Institute for Molecular Genetics Presented

#### Structure, Projects

91WS0526A Budapest *BIOTECHNOLOGIA ES KORNYEZETVEDELEM in Hungarian*  
Apr 91 pp 17-19

[Article by Laszlo Orosz, university professor and institute director: "Introducing the Molecular Genetics Institute of the Agricultural Biotechnology Research Center"]

[Text] There is no other Molecular Genetics Institute in the country; this is the first to bear this name. A harmony between the activity and the name is a goal devoutly hoped for. Nomen est omen. There are foundations. Strong bases have been built up primarily in Szeged (the SZBK [Szeged Biology Center] and the JATE [Attila Jozsef Science University]) and Debrecen (the KLTE [Lajos Kossuth Science University] and the DOTE [Medical University of Debrecen]). Molecular genetics can be regarded as one of the successes of domestic science if we make comparisons on the basis of the tables of contents of international scientific journals.

Genetics is a uniform science, its finely chiseled logic is welded without a hiatus from the "classical" and "molecular" viewpoints alike. Peas, wine flies, phages, bacteria, nematodes and wheat follow the same laws. Cistron, complementation, "9:7 splitting" or "balanced lethality" are leaves of the same driving force. At the Molecular Genetics Institute classical genetics will not lose its decent rank, as long as it depends on me. Its approach will imbue everyday work; it will be lurking in every professionally demanding thought. This institute is starting in such a way that the director is adopting the spirit of Professor Mr. Barna Gyorffy, founder of the school of Hungarian genetics. His example is regarded as the guide even today, as are the teachings of Professor Artur Horn, creator of the world famous Hungarian school of applied genetics.

#### Structure of the Institute: Autonomous Groups

The nucleus of the researchers at the Molecular Genetics Institute was recruited from the Szeged genetics school, and it was joined by colleagues from the most varied outstanding intellectual workshops. Agricultural engineers, biologists, biological chemistry teachers, and biological engineers are represented, as are the SZBK, the JATE, the GATE [Godollo Agricultural Sciences University], the ELTE [Lorand Eotvos Science University], the KLTE and the Ujvidek [Novisad] and Pozsony [Bratislava] TTK and the Szekelyudvarhely Academy. The laboratory assistants have come from trade secondary schools which give very good training, or they have joined us after considerable practice. The staff is extraordinarily young; the great work of Professor F. Bruno Straub, the Szeged Biology Center, was like this in 1972.

At the Molecular Genetics Institute the unit for research is the "small team" which has three to five researchers and might include a senior researcher, a laboratory assistant, a scholarship intern, a graduate student, and a university student researcher. The "small teams" are assigned to independent larger units managing with their own part of the budget; these are held together by a research theme and a responsible theme leader. There are six such units in the institute. They receive, for a limited time, a proportional share in the central assets of the institute after debate and agreement among the theme leaders.

The several theme leaders have successfully competed for research funds from the National Scientific Research Fund (OTKA) and the National Technical Development Committee (OMFB). They can dispose of these funds freely, and the same would apply to the foreign cooperation projects now being organized (UNESCO/ICGEB, USAid, U.S.-Israel-Hungary, etc.).

#### Concerning the Role of the Institute

If I consider—forgive me for the first person usage, if after the fact—the material equipment of the MBK [Agricultural Biotechnology Research Center], the training of the researchers, the proximity of large universities and the goals which can be aimed at and attained here—then I see the "proper" utilization of the Molecular Genetics Institute to be the performance of basic genetics research at the international level, supporting Hungarian agriculture by using gene technologies and cellular genetics procedures, thus enriching the intellectual capital of Hungarian agriculture. Accordingly the work of the institute can be put into three main activity spheres: biological basic research, development of gene technologies for agricultural purposes, and university and postgraduate education.

#### The Research Program

Basic research and "high tech" development share half and half in the research of the institute. The themes are organized around two "academic axes" (transcription gene control and location specific DNA recombination) and four developmental goals: transgenic fish, the RFLP laboratory, feed supplementing amino acid fermentation—the Brevi bacterium gene splicing laboratory, and the wheat gliadin gene—and transgenic rice.

The concrete themes are the following:

- I. The Molecular Link Between the Regulator Protein and DNA; theme leader, Laszlo Orosz

The goal is to discover the combination background providing the interlocking laws for protein molecules and DNA surfaces and the extraordinary specificity of the process. Internationally recognized results have

already been achieved. This research is being done in cooperation with the "computer graphics" and "synthesis" team (led by Sandor Pongor and Andras Patthy) of the Biochemistry and Protein Design Institute of the MBK. The theme has the support of the OTKA, OMFB, and UNESCO/ICGEB and is tied closely to a research team at the National Cancer Research Institute in the United States (Bethesda, NIH, NCI).

## II. Location Specific Recombination, Building Genes Into Chromosomes; theme leader, Ferenc Olasz

The location specific recombination occurring generally in living things is a system made up of four elements: two enzyme functions (transposases and integrases, and resolvases and excisases) and two types of DNA sequences (sequences active in recombination and "target" locations: attP and attB regions). The enzymes split the DNA sequences and put them together in new combinations. The goal of the team is to "separate" and clone the DNA section active in recombination and the genes coding the enzymes and thus discover what chemical reaction sequence leads to the linking of the sequence active in the recombination and the "target" DNA. We want to clone the elements of location specific recombination from both moderated bacteriophages and "jumping genes." This research might be a starting point for developments very soon because it could serve as a basis for a very effective and controllable gene insertion technology. For example, the team plans an advantageous genetic transformation of the nitrogen binding bacterium living in a symbiosis with alfalfa. The theme has OTKA support. There are research links to the Genetics Institute of the SZBK here at home and abroad to the Biological Center (Biocentrum) of the Basel University, to the genetics department of Glasgow University, and to a research team of the Wageningen University.

## III. The Transgenic Carp; theme leader, Laszlo Orban

The chief goal of the research and development is development of a gene insertion technology which can be used with fish. This includes transformation of the fish cell (DNA insertion), isolation of a marker gene to indicate transgenic individuals and cloning of fish from an individual cell. The first "target gene" to be used in the development is to be the growth hormone gene; building it into a carp (or possibly a tropical channel catfish) could result in a quick growing transgenic fish. (In a separate article in this same journal I will give a more detailed analysis of the origin and status of this program.)

The theme developed out of the Triton Program of the OMFB. Close national cooperation has developed primarily with the fish biology team of the Animal Husbandry Institute of the GATE (led by Laszlo Horvath), research teams from the SZBK Biochemistry Institute and the HAKI, and with research teams abroad (Wisconsin University and Bethesda NIH in the U.S.,

Southampton University in England, the Basel Biocentrum in Switzerland and the Koln University in Germany). The team is competing with the theme in the U.S. Aid program.

## IV. The RFLP Laboratory; theme leader, Laszlo Varga

The chief task of the team is to develop a basic laboratory for the RFLP technology for the entire Biotechnology Center, which means collection and development of DNA probes, setting up software to evaluate RFLP samples, and preparing comparative gene maps of domestic animals. We are publishing a separate article about the developmental and service research of this laboratory. Let me mention here only that they are working on a possible way to improve meat quality by genetic means. In addition they are preparing ways to precisely characterize breeding animals, to perform paternity tests, and to identify economically significant plant and animal genes. Close domestic cooperation has developed with the ATK. In cooperation with the leading research team in Israel, they have competed in the U.S.-Israel-Hungary research support program.

## V. Fermentation of Feed Additive Amino Acid—the Brevi Bacterium Gene Splicing Laboratory; theme leader, Klara Dallmann

The research goal is to develop, by gene splicing means, a Coryne bacterium strain which can effectively transform indol into tryptophane. The latter is a vitally important protein constituent; there is little of it in the protein of plants, and the deficiency must be made up from outside in feeds. The bacterium to be developed should be capable of being used for the development of a bound cell fermentor to transform surplus indol, free of mutagenic and cancer producing materials, into tryptophane suitable as feed.

The Coryne bacteria and the Brevi bacteria in general have great fermentation industry significance. They will collect and have ready in this laboratory the gene splicing tools suitable for the above bacteria (vectors, strains, DNA insertion procedures). Research is also planned on the possibilities of fermenting the threonine amino acid.

The laboratory has begun to build up close cooperation with the Brevi Bacterium Laboratory of the Molecular Biology Institute of the Slovak Academy of Sciences (Bratislava). The domestic cooperation partner is the Reanal Fine Chemicals Factory.

## VI. The Wheat Gliadin Gene—Transgenic Rice; theme leader, Geza Dallmann

The goal of the development is to "enrich" rice with the gliadin gene of wheat, to give a more valuable grain. One team each from the MBK Plant Biotechnology Institute and the SZBK Plant Biology Institute are the planned cooperating partners. An analysis of the regulating region of the gliadin gene constitutes the basic research part of the theme which can be used for future developments.

It is hoped that if another target gene is connected to this region then it too will function in the nucleus, that is, that we will get to a nuclear specific gene expressing element.

Another use is that RFLP probes can be developed from the gliadin gene family, for example, for strain identification. The team has a "gene library" for wheat, and they are planning, in cooperation with various domestic institutes, to perform molecular identification of various genes which are significant from the viewpoint of strain improvement.

The famous Friedrich-Miescher Institute (FMI) in Basel represents a valuable foreign contact for the team.

### Instruction

The institute participates in the main collegium teaching of genetics at the GATE and JATE. The author of this article is a regular university professor at the GATE, in conjunction with the Animal Husbandry Institute. We regularly give lectures in the various genetics main collegiums in the areas of, in a vertical analysis of the gene concept, Mendelian genetics, gene mapping and crossing over, genetic recombination, gene splicing, genetic regulation, animal genetics, and developmental genetics. We also plan to hold independent university main collegiums. We brought with us from Szeged material for a course of about 120 to 140 hours of genetics lectures and the same number of laboratory exercises. The institute also regularly announces special collegiums. Scientific student club research is developing intensively; skilled workers are recruited primarily from among the students of the GATE, but we also have student researchers from the ELTE.

The institute also has a role in postgraduate training. The group has one MTA TMB [Hungarian Academy of Sciences Committee on Scientific Qualifications] scholarship intern and seven doctoral candidates.

We consider the chief goal of our instructional activity to be establishing the Szeged genetics school in Godollo and integrating into agricultural higher education the discipline of molecular genetics and a uniform attitude for classical and molecular genetics.

It would fill us with the greatest satisfaction if time were to transform our laboratories into workshops for research and instruction and if the future saw our researchers maturing into professors.

### The Triton Project

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[Article by Laszlo Orosz: "The Transgenic Fish; Notes of a Witness"]

[Text] Changes by means of gene insertion in the genetic information of higher order eucaryotic organisms has

opened new possibilities in the study of the functioning of vertebrate organisms and in a deliberate changing of them. The success of the first transgenic mouse experiments, since become a classic, not only accelerated the development of such basic research trends as gene regulation, individual development, and a study of the effective mechanism of oncogenes but also initiated medical and agrobiotechnological themes which promise practical profit in the shorter run. Among the later there is a very high degree of interest in experiments the goal of which is to improve the properties of domestic animals by the methods of gene splicing.

The fishes have a number of properties which are very favorable for transgenic research. Their eggs are numerous; their size many times that of the egg cells of mammals. In many species egg cells and sperm can be obtained throughout the year. The external fertilization is easy to reproduce artificially, and their individual development is usually very fast compared to other vertebrates. The relative cheapness of growing costs makes it possible to maintain many more progeny than would be possible with domestic mammals.

Many fish breeding experts see a solution to the serious food problems of the period following the millenium in developing recombinant fish types which grow more quickly and are more resistant to disease. The cost per unit weight is by far the lowest for fish meat. It is not by chance that in addition to countries devoting billions to scientific research a number of developing countries (such as India, Indonesia and China) struggling with quite a few economic and food problems are making serious efforts to produce transgenic fish types with more favorable properties for fish raising.

### The Domestic Chronicle

Miklos Bercsenyi, a biologist from the HAKI in Szarvas, noted the possibilities hiding in the domestic production of transgenic fish at the very beginning, in 1986. He raised the problem in Szeged which led to the participation in the program of the Genetics Department of the JATE, and later, after the Szeged exodus, of the Molecular Genetics Institute of the Agricultural Biology Center. The initiative of Miklos Bercsenyi and his unflagging organizational work found an understanding hearing with the National Technical Development Committee where Laszlo Kallay personally undertook to manage the program. Thus was born the "TRITON" program, which brought with it two domestic experimental biology researchers of international fame, developmental biologist Laszlo Horvath, professor of fish research from Godollo, from the Animal Breeding Institute of the GATE, and molecular biologist Erno Duda, from Szeged, from the SZBK Biochemistry Institute.

Both scientists are teachers who really created a school. A number of young researchers from their shops have already entered the domestic scientific community. It was no different this time. Erno Duda and Laszlo Horvath were immediately joined by student researchers

who were given their first independent research experience by the transgenic fish program.

The year 1988 brought a new turn. Then, still as leader of the JATE Genetics Department, I assumed the leadership post in the MBK Molecular Genetics Institute. I immediately set about organizing a research program for the Institute, and I was very quickly convinced that the new institute should take over the "transgenic fish" program. The question was how to fit all this into the TRITON program and whether we could find a theme leader of appropriate quality. The name of Laszlo Orban came up then. At the time he was working as a molecular biologist-biochemist in the famous biological research institute of the United States, the NIH in Bethesda. I knew that he had been working for years with the enzymes of fish and in addition was qualified in general genetics. I asked Laszlo Orban to prepare a theme plan independent from the TRITON program. Just at that moment they were holding an international symposium at the NIH on the creation of transgenic animals. Laszlo Orban could immediately make personal acquaintance with the international experts in the field. His work, the "Transgenic Carp" theme plan, his precise care, attentive to everything, and his perfect professional preparation convinced me, and it convinced the Scientific Council of the MBK, where it was classified as the best theme plan at the beginning of 1989. The next task was to bring the TRITON program and the Orban program together with the Horvath school. This did not seem difficult professionally. The contribution of the team working at the GATE, the Horvath school, meant primarily a development of the embryological, developmental biology side of the problem. Those at the SZBK, the shop of Erno Duda, regarded as their chief task the preparation of the DNA designs, the transformation of the fish cells.

In this division of labor the solution of the various questions of further breeding fell on the HAKI laboratory in Szarvas, the Bercsenyi team, in accordance with its profile and possibilities. In many ways the Orban program overlapped with the Triton program but in three very essential points it went well beyond it:

- It had a marked emphasis on the search for alternative possibilities for DNA insertion; it had as a goal the isolation of a so-called "marker gene" which is a key point in the approach around the world; and
- It recommends, in addition to the growth hormone gene, a number of other "target genes" the insertion of which into the genome of the carp could result in an acceleration of growth.

A scientific fitting together of the programs was a rational thing, but in itself it was no guarantee of a successful division of labor. There is also a need for the critical cooperation of sovereign researchers who respect and value one another. It appears that luck is now helping science; truly collegial working relationships have developed among biologists who supplement one

another's thinking and expertise. There is everyday cooperation and a division of labor at Godollo between the teams of Laszlo Horvath and Laszlo Orban; the people at Godollo regularly swing over to Szeged, to the laboratory of Erno Duda, for a series of experiments, and vice versa. This friendship and modest quiet is a striking thing in our world noisy with wild ambition.

It is my opinion that the entry of the MBK Molecular Genetics Institute into the domestic "transgenic fish" research and development program will shift the emphasis to Godollo. The physical and professional fusion of the GATE fish development and breeding biology laboratory, and the MBK, MGI molecular genetics laboratory at Godollo means a powerful concentration of intellectual forces. And the lively interest found among the university students ensures a continual handing on of and recruitment for the theme.

Experiments in the domestic transgenic fish program began with two species of fish: the carp and the tropical channel catfish. International tradition and the domestic possibilities favor the carp. The advantages of the channel catfish are an extraordinarily small oxygen requirement and tolerance for water pollution. The experiments described below were done with both fish species.

#### Transforming Fish With DNA and Alien Genes

The first in vitro experiments to create recombinant, also known as transgenic, fishes were performed—presumably for reasons of convenience—with methods worked out for, and well proven there, mammal systems in the course of transgenic experiments performed on mice, and they are so performed today. In most cases, for example, they attempt to insert the alien genes (the "transgenes") by microinjection, despite the fact that this procedure is time consuming and demanding, and due to the failure to recognize early the individuals carrying the transgene the advantages given by the large number of eggs and the external fertilization and embryo development remain unexploited. Since it is not possible to separate the transgenic individuals from those in which the alien gene has not been inserted, they trust to luck, the former being identified only after raising and checking many, many animals, with a great deal of work.

So a new approach is needed, using a system in which it is possible to make use of the advantages lying in the differentness of fishes. In our opinion it is necessary to work out two methods for this:

1. A simple and fast procedure with which one can insert at once the desired gene design in a large number of egg cells or zygotes or a few cellular blastula; and
2. The introduction of a "marker gene" the manifestation of which will indicate externally the transgenic individuals, thus making possible a "screening" for the purpose of isolating the transgenic individuals.



In order to "replace" microinjection my colleagues have worked out or are developing further two mass gene insertion methods. We will talk about this in the next section.

### The Sperm Passenger

Following experiments by Italian researchers on mice the researchers of the GATE and MGI teams mixed the alien DNA with fish sperm and found a way to attach at least 100 DNA molecules or gene designs to the surface of each sperm so strongly that they cannot be removed by washing or other physical treatment. Only the DNase treatment, that is the enzymatic breakdown of the DNA, led to success. Very foresightful and expensive work lies behind the expression "alien" DNA. We are talking about plasmid designs, of two types. In one they built in the gene of the enzyme responsible for breaking down neomycin (the neo) and in the other they built in the gene for beta galactosidase (the beta-gal). In both plasmid designs they planted eucaryotic promoters in front of the genes, so the neo and beta-gal genes could function in fish cells. And this is not all. They had to reckon with the fact that the designs would require a lot of DNA, so they made a "shuttle"—they built in a procaryotic replication origin, a procaryotic promoter and a manifesting selection gene. After this "legerdemain" the entire plasmid can be propagated in bacteria and can be produced purely in vast quantities. Our researchers fertilized the eggs with the sperm carrying the DNA; a few percent of the fish developing from the egg cells thus fertilized carried the alien gene and thus were "transgenic."

### Liposoma, the DNA Trojan Horse

The origins of the procedure were developed years before in the laboratory of Erno Duda in the Szeged Biology Center. With its aid DNA was inserted into the cells of tissue cultures. The essence of the procedure is that the DNA molecules, the alien genes, are packaged into liposomes, artificial membrane spherules. The membrane of the liposome can meld with the cell membrane, emptying the genes in it into the interior of the cell.

Two points had to be developed when adapting the technique. First the fish eggs or the fertilized egg cell had to be put into a state so that its membrane could be reached by the liposome spherules. In the second place it had to be ensured that enough DNA would get inside the liposomes.

They achieved extraordinary DNA density and good cell-liposome fusion with precision micromanipulation methods and—an unexpected association—a combination of bacteriophage genetics. We should say a few words here about the design of the alien DNA. It contained two bacterium genes: the kanamycin phosphokinase and the chloramphenicol acetyl transferase genes. Both genes were "equipped" with eucaryotic promoters which also ensured their functioning in the cells of fish.

The entire design was built into a bacteriophage. The phage thus transformed still proliferates well. At the end of growth there may be  $10^{11}$  individuals in a single ml. This concentration can be increased further, even 100 or 1,000 times, by very simple procedures. Fifty percent of the phage particles are DNA. An enormous number of phage particles can be packed into the liposomes, and this is done very compactly. The result surpassed all expectations: The DNA section coming from the bacteria could be demonstrated in a third of the growing fish, and in such a way that both genes remained whole and functioned perfectly. The activity of the enzymes coded by the genes could be proven without doubt.

Here also important questions remain to be clarified. Was the inserted DNA built into the chromosomes of the fish? Might it be reproducing in the cytoplasm of the cells like, for example, mitochondrial DNA? How are the built-in genes inherited—in the Mendelian way? Or in the cytoplasmic (maternal) way?

### Which Is Better?

The results could point far ahead. With the liposoma procedure the chance of producing a transgenic individual may be much greater than with any other method. If the 30 percent frequency experienced can be reproduced reliably then solution of the "marker gene" problem is not such a burning question (see below) because of the individuals examined for a "hit" every third one would be transgenic. The highly probable production of transgenic individuals does not yet mean that the liposoma procedure can produce a numerous transgenic population. The method requires the individual preparation of the eggs. So we might characterize our hopes by saying, "Every third, of a few." It is in vain that the liposome is an efficient mailman; at present the method cannot be used to produce so many transgenic individuals as to give prospects for the selection of rare transgenic examples meeting the many requirements.

The procedure done with the aid of sperm led to transgenic fish a good bit less often. But this is not necessarily a disadvantage. It can be done at one time to a gigantic number of eggs and sperm, which could ensure the production of a large number of transgenic individuals. There is also hope that the method can be used generally. The experiments were successful with both carp and channel catfish (and recently we have heard of successful attempts with poultry).

In addition to the transgenic individuals produced in large numbers 50 to 70 times more nontransgenic fish developed from the mass of treated eggs. And here we must again return to the "marker gene" question. If the multiplicity of transgenic individuals could be selected by virtue of the marker gene then their numbers would make further selection possible. We might select those transgenic individuals which best suited the announced goals, even if they appeared only rarely. There might be a need, for example, to build a "transgene" along side of or in place of some selected gene at a definite point in the chromosome, etc. It

is not by chance that the "Transgenic Fish" team aroused serious international interest in the United States. The national cooperation in research may be expanded into international cooperation.

Still, a number of tasks remain to be solved. If the procedure is to be developed into a technology satisfying the highest scientific requirements we must concentrate on two additional questions: the question of the so-called "marker gene" and the question of "cloning." The former, in the event of suitably deliberate planning, might make it possible to distinguish transgenic individuals from their nontransgenic sisters at a very early age (their "phenotypes" would be different); with the aid of the latter a given transgenic individual might be used to create numerous, perfectly identical "twins." In this way one might create the "isogenic" population needed for further breeding or studies.

### The Marker Gene

Researchers working on *Drosophila* (musica) have enjoyed for a long time the advantages of the use of marker or reporter genes in distinguishing transgenic individuals. In the study of mammals it is necessary to replant the embryo in the womb, so one can deal with few individuals. One cannot think of selecting transgenic individuals which meet many requirements, and thus appear rarely. This is not so with fish, where—as we mentioned above—domestic colleagues have been able to produce large numbers of the most varied transgenic individuals. By connecting a rationally selected marker gene directly next to the target gene one could easily screen out the transgenic individuals on the basis of the connection. Additional, detailed studies would be done only with these. Our researchers at the MGI are trying to isolate "neutral" (that is, nonvital) marker gene variants (alleles) the use of which would make possible fast visual selection of transgenically positive individuals.

For example, one might think of skin pigments or a suitable allele of a gene controlling scale development. It is an important requirement that we introduce the dominant allele of the marker gene into the cells, cells which contained the recessive allele originally. Godollo recently received from Israel colored carp strains which we want to use for the isolation of a marker gene.

In the case of *Drosophila* and in the culturing of undifferentiated mouse cells a well proven method is the use of so-called "gene trap" vectors to identify and change the genes controlling embryogenesis. A reporter gene without a promoter is inserted into the cells, so for it to be manifested it is necessary to build it in behind a promoter which is active in a given developmental phase. There is a dual result: The reporter gene begins to function, at the same time the functioning of the original gene is damaged or left out. Thanks to the product of the reporter gene such a cell line can be identified well and in the mice grown from it one can study the phenotype effect of the damaged original gene. Since the product of the inserted reporter gene forms a fusion protein with the

product of the structure gene behind the promoter one can elicit and identify the structure gene with its aid. They are already working on adaptation of the "gene trap" at the Molecular Genetics Institute in Godollo. Nor has international cooperation been lacking; interested aid has come from the Cell Genetics Institute of the Biocentrum in Basel.

### Cloning

At the Biotechnology Laboratory of the Animal Breeding Institute of the GATE our colleague Laszlo Horvath and his students have succeeded in isolating a small group of diploid pluripotens blastula cells, that is, they are capable of full development, and then after virtuoso solutions they grew them into fish with the aid of haploid "nursemaid" cells. After completing their task the haploid cells die. The blastula cells are genetically identical, like single egg twins. If we can isolate them as individuals and then grow them into fish then we will have created clones from the same blastula, we will have created a group of identical individuals. With multiple repetition it would be possible in principle to create an infinite number of clones from a single blastula.

I must mention that the idea for the above procedure originated from our friend Andras Nagy (ELTE Genetics Department), who developed it for the cloning of mice. It was nature's bad joke that the cloned mice did develop and were born, but quickly died. The fish, on the other hand, live.

Our researchers want to introduce their modified "gene trap" vector into the fish embryos. Then, studying on the fish raised from the cells the phenotype effect of the genes destroyed as a result of having built in the gene trap, they will track down genes which can be used as markers. In addition to its practical utility this procedure could give answers to previously unsolved, important questions about the individual development of fishes, indeed of vertebrates in general. But before that another step must be taken. Namely, the procedure of Laszlo Horvath was successful if they started from a small group of the pluripotens blastula cells. This is not yet cloning. It becomes cloning if one can get a fish starting from a single cell. In this case a number of individuals can be grown from the sister cells of the same blastula and these, as I mentioned, will be genetically identical (like single egg twins). An alternative solution might be to "break in pieces" the pluripotens blastula cell stock, that is, to isolate several smaller cell groups from the same blastula and then grow each of them into fish. These fish also could be regarded as single egg twins or clones.

So the importance of the marker gene and of cloning lies not only in simplifying the selection of transgenic individuals but primarily in the fact that this might open the way for building in any deliberately chosen gene before checking its effect independently, free of selection pressure. Only this could be the scientifically correct procedure, adhering to the rules of genetics. I do not deny that

the multiplicity of professionally careless and noisy transgenic animal experiments have evoked this observation.

#### What Should the "Target Gene" Be?

With the aid of the marker gene we recognize the transgenic individuals. But the target gene is the gene whose effect we want to study or by the insertion of which we want to produce a new strain which will bring greater economic profit. In the gene design which we want to insert in the cells in connection with the vector we build in side by side the marker gene and the target gene; if the marker gene shows that "it" has been built into the transgenic individual then we can be almost certain that the target gene is there beside it.

We might consider as target genes the genes which improve resistance to sickness or cold or which accelerate growth. At present the Hungarian group is working on the latter. At the Molecular Genetics Institute and the SZBK they have succeeded in isolating the growth hormone (GH) gene of the carp. The GH gene has already been isolated from a number of animal types and by building it in repeatedly they have obtained transgenic animals with gigantic growth. (With proper biological insight one can see that in many cases the gigantic growth is not a necessary effect but merely the work of chance. In other combinations the transgenic individual might even be a dwarf.)

A gigantic (or rather very fast growing) carp is already known—an inaccessible treasure "kept under lock and key." We at Godollo must first produce a "Hungarian version" ourselves. But other genes encouraging growth are known in addition to the GH gene; by building them in we might get transgenic strains with more favorable properties.

Tolerance to cold is given by genes which control the fluidity of cell membranes, the ratio of saturated and unsaturated fatty acids and the arrangement of the fatty acids around larger structures. The temperature requirements of tropical fish might be reduced so that breeding in the temperate zone might be achieved in transgenic strains bearing such a gene.

Resistance to various diseases can also have genetic causes. This has been known for a long time. Breeders make use of it when they produce strains resistant to certain diseases. If one or a few (but connected) genes or alleles are in the background of the resistance then by building in these genes one might produce transgenically resistant individuals. After cloning the resistant strains might serve as starting material for a little troop of twins.

#### DNA-Polymorphism Experiments

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[Article by Laszlo Orosz and Laszlo Varga of the MBK Molecular Genetics Institute: "DNA-Polymorphisms, the Plan of the RFLP Center"]

[Text] Animal breeders try to make use of all information (the performance of progenitors, descendants and the individual itself) to produce cows which give more milk, hogs of greater weight or faster running horses. Since we still know little about the precise genetic background of these properties, we use the data thus gained and the mating of individuals with outstanding performance to increase the probability that the gene variants (allele combinations) resulting in the favorable phenotype will be passed on to succeeding generations.

The biological revolution taking place today has created a number of methods and techniques which have opened a way for us to learn in the future the genes playing the chief role in these properties, to know which chromosomes they are on and how we might influence them in the interest of increased production. One of the most important of the new techniques is "RFLP" (long polymorphism of DNA restriction fragments) which, like many of its fellows, relies on gene surgery. The essence of it is that it indicates the tiny displacements of DNA molecules in individual chromosomes even if these displacements do not affect genes and have no inherited phenotype effect. The differences which can be shown by the RFLP technique are commonly called molecular markers since they directly indicate differences in individual groups of atoms in the DNA molecules.

The DNA polymorphism technology can be used generally in the biological world to characterize the chromosomes of plants, animals, viruses and even men. With appropriate precision one can obtain polymorphism samples (we might also call them the line codes of the chromosomes) on the basis of which one can identify not only species but even individuals. Such samples are also commonly called "DNA fingerprints" because they are unique, like fingerprints in men. They can be used in agriculture to identify (protect) strains or to prove derivation or paternity. What is more important one can identify important genes with its aid, and this identification cannot be influenced by the environment, it is not necessary to grow an entire plant or animal to make the identification—a few cells, a little DNA is enough. In addition, the DNA polymorphism sample can be interpreted with the tools of "classical" Mendel-Morgan genetic analysis, giving a nice example of how classical and molecular genetics are welding into one in the uniform genetic approach of our day.

An RFLP team or laboratory has been formed in our institute under the leadership of Laszlo Varga. With time we plan to develop the little laboratory into a regional center where we will stockpile an arsenal of the most

varied DNA probes needed for RFLP studies and the computer software needed to evaluate and compare the DNA fingerprints. We will have a catalog here of the gene maps of the most varied domestic animals, plants and plant and animal pests. But before all we will not neglect to educate trained specialists, developmental and research agricultural engineers and biologists. One can expect an intellectual concentration which may radiate far in domestic agriculture. From the beginning the general goal of the "RFLP" center has been to map for various species of domestic animals the properties which are significant from the economic viewpoint. In their current research they are trying to identify the effective genes which significantly influence properties connected with meat production (growth vigour, body mass increase, meat forms).

The most important study methods in their gene mapping research are genetic mapping based on DNA polymorphisms and comparative gene mapping.

#### Genetic Mapping Based on DNA-Polymorphisms

In the course of genetic mapping we insert into the map genes which are new relative to the genes already mapped on the various chromosomes. This method has been known since the beginning of the century (crossing over analysis, two and three point genetic mapping, "Morgan genetics," etc. are parts of every genetics course in the university), but it could not be used effectively for mammals because only a few genes which could be used as good reference points had been mapped relative to the sizes of the chromosomes. The requirement made of these genes is that they be simple to show, have many allele variants and be "spread" evenly along the chromosomes and not form a closed group.

The DNA polymorphisms discovered in the past decade meet these requirements very well. They are relatively easy to locate in the gene map and their chief task there is to serve as reference points in the mapping of real ("important") genes. With the increase in the number of mapped DNA polymorphisms one can create a marker network which—evenly enmeshing the chromosomes—is suitable for localizing almost any gene. The gene maps of mice and men and of a number of cultivated plants are swiftly approaching this state.

There are two chief forms of DNA polymorphisms—RFLPs (restriction fragment long polymorphisms) and VNTRs (variable number tandem repetitions).

The RFLPs arise from mutations which take place at the splitting sites of restriction endonucleases. They are inherited in the codominant manner, generally with only two allele versions, but this is compensated for by the fact that they can be found in large numbers in every part of the genome—even in the introns.

The polymorphism of the VNTRs is given by the number of different repetitions of a tandem repetitive DNA sequence. We can break the VNTRs down into two additional groups depending on the length of the

repeating sequence into minisatellites and microsatellites. Since the number of repetitions—corresponding to the several alleles—which can be found at a chromosomal locus can show considerable differences there are very many types of these loci and the degree of their heterozygosity is astoundingly high.

Frequently the repeating sequences of VNTRs occurring at various chromosomal sites show great similarities, so with the so-called multi-locus DNA probes, one can indicate fragments corresponding to a number of VNTR loci at one time. We call the complex DNA sample thus obtained a fingerprint. As noted above the fingerprints can be used with great efficiency in gene mapping, in identifying individuals and in checking derivation.

#### Comparative Gene Mapping

Upon comparing the gene maps of men, mice, cattle and other mammals it was discovered that mammal genomes contain a number of very similar (conservative), very extensive regions or sections containing many, many genes, regions which have changed little in the course of evolution. There are already sufficiently detailed gene maps, primarily in regard to mice and men, so that one can predict in a species the probable location of a gene which has been mapped in another species (mapping software aids this analysis). The gene maps of domestic animals are still rather primitive, that is the location of few genes is known. Using the detail rich gene map of mice it is best to begin the studies on mice and then transform the interdependencies found there to the given domestic animal species. Those working at the RFLP laboratory are trying this method; it may become one of the prime breeding strategies of the coming century. A number of factors motivate the approach using the mouse as an intermediary: In addition to the finely resolved gene maps there are comparative maps, the unbound nature of the crossings, the variety and large number of inbred strains, the short generation interval, the small individual value, etc.

Translating it into the language of future breeders all this means that first we must find the important gene or allele in a mouse, a gene which is responsible for an economically desirable property, and then, with the aid of the RFLP and VNTR techniques, the gene, as a DNA sequence, can be identified and isolated from a mouse or a cow or other domestic animal. The isolated gene (which can be modified too) can be inserted in zygotes, egg cells, etc., and finally the desired transgenic organism can be the final result, which can be used to develop a new strain.

#### The "Compact" Mouse

The RFLP team members are performing their first studies on a mouse mutant which stores virtually no fat and which shows stronger musculature than the average.

The goal of the research is to map the gene or genes which are responsible for the development of this phenotype and to transform the results to hogs and cattle.

The mouse crossings now being done will give an answer to how many genes are responsible and to what degree for the "compact" phenotype. The inheritance analyses thus far suggest one powerful "main" gene the phenotype effect of which is modified to a greater or lesser extent by other genes. The approach will continue on two paths. On the one hand they will study, with various fingerprint probes, the descendants from the crossings in order to find the minisatellite locus which is near the gene or genes. On the other hand they will try to do the mapping with the microsatellite loci already assigned to the chromosomes. First they must determine which chromosome carries the gene, then specify the chromosome region and the group of neighboring genes. As we mentioned above the gene group thus defined may be present in a similar form in cattle and hogs.

### Genes and Growth Vigour

The next research plan of the RFLP team is to try to map and identify those genes which have a strong effect on growth vigour. It is their hypothesis that a similar gene combination may play a role in the development of greater growth vigour for both domestic animals and mouse strains specially selected for this. In this experiment, after performing the crossings, they must work with DNA probes which represent genes which have a proven or supposed connection with growth vigour. Isolation of the DNA probes is being done within the framework of an international division of labor. The RFLP laboratory must join in this division of labor.

### Checking Derivation—Degree of Heterozygosity—Heterosis Enrichment

We spoke above about the outstanding efficiency of DNA fingerprints in the area of checking derivation. Practical animal breeding requires that the laboratories specialized for this be able to carry out this sort of activity (service) at an ever higher level. Since the known fingerprint probes are all patented it is important to develop our own probe set as soon as possible, one suitable for efficient individual identification and derivation checking.

Finally, we would call attention to the extraordinarily broad utility of the RFLP technique in the heterosis enrichment of cultivated plants and domestic animals, in selecting suitable parents and populations. With its aid one can establish with very great certainty the several breeding stocks, lines, homozygosity of individuals and genetic differences. In general an animal or plant breeder expects the greatest heterosis effect, the most productive hybrid generation, from the crossing or hybridization of lines showing great differences.

### Protecting Nature, Wildlife Management

A few words should be said also about the use of the method in protecting nature and wildlife management. With the aid of DNA probes one can estimate very well the gene pool or degree of heterozygosity of populations living in the wild or those surviving only in zoos. Thus

one can develop, for example, a strategy for propagation of a species threatened with extinction or one could obtain characteristic data about the genetic status of populations representing outstanding wildlife management value. The outstanding Hungarian deer or the fallow deer might be subjects for an RFLP survey.

### A Strategy for Targeted Breeding

The properties of outstanding significance from the economic viewpoint are generally quantitative characteristics or properties of cultivated plants and animals. The combined functioning of many genes or alleles is responsible for the quantitative properties (such as prolificness, milk yield, body weight, average yield, meat production, etc.). But we do know of main genes some allele of which can influence the total effect in a decisive and favorable way, thus influencing the breeding or economic value of the given genotypic individual. The problem is that these advantageous main gene-alleles are located on a given chromosome "linked" with various alleles of other genes. In the course of strain development performed with traditional crossings the alleles of the linked genes in addition to the gene (or allele) determining the advantageous property are built into the gene stock of the new strain (indeed, even other gene groups on different chromosomes are so built in) and some of these may have a number of unfavorable effects (for example, weak prolificness with good meat production). The "unfavorable" alleles of the linked genes could be replaced in a natural way with the aid of "crossing over," with the aid of recombination. But it is known about recombination that it very rarely takes place in the case of genes located close to one another. In the case of our domestic animals, it would be hopeless to wait until enough descendant individuals had collected among whom one might hope to find the desired recombinant example. And just here the new molecular genetics and cell genetics technologies might help. With the RFLP and fingerprint procedures one can identify the advantageous main gene-alleles in question, one can prepare so-called "DNA probes" and with their aid one can extract the gene (or allele) from the chromosome, clone it in plasmids, and with the aid of the new DNA insertion and integration technologies it can be placed in the egg cells or zygotes from which a transgenic individual can be grown. So this individual will differ from the original zygote only by the gene subsequently inserted. So the gene stock of the zygote will have been enriched not by a combination of genes or their alleles but rather by a single gene, by a single allele of it, by the allele desired. Thus the advantageous allele of a main gene significant from another viewpoint will have been "smuggled" into a strain which has an advantageous gene stock from some economic viewpoint.

The "culard" gene influences the meat producing capability of cattle to a large extent, the booroola main gene is significant in the prolificness of sheep, the stress tolerance (halotane) gene significantly influences the quality of pork, the kappa-casein gene determines the industrial value of cheese, the growth hormone genes

determine growth vigour. There is a cold tolerance gene in grain, etc. These are all main genes which might be considered in the targeted development of genotypes, in the first targeted enrichment plans. And we have not yet spoken of how the gene (or its allele) to be built in need not come from the same species. Considering the possibility of gene exchanges between species (for example building a sheep gene into cattle) the combination variety can be expanded to an extraordinary degree.

#### **The Scientific Contacts System of the RFLP Center**

The classical animal genetics school of Professor Janos Dohy in the Animal Breeding Institute of the GATE and the contacts system built up with the Molecular Genetics Institute of the MBK provide a basis for the development of a national RFLP network.

The RFLP team is cooperating closely with the Genetics Department of the Animal Husbandry and Feeding Research Institute. The sheep and hog derivation tests are performed here nationally under the leadership of director-in-chief Dr Laszlo Fesus. The probe sets developed by the RFLP team will be used in practice here.

We can expect broad cooperation with the Hog Breeding Department of the Pannon University under the leadership of Professor Dr Peter Horn.

The contacts system being built in the direction of animal breeding does not mean that we do not consider it desirable and important to have a development suiting the needs of plant breeding. The RFLP technology, like its "parents" genetics and molecular biology, can be used generally in the biological world.

#### **Possible Technology To Develop Homozygotic Lines**

*91WS0526D Budapest BIOTECHNOLOGIA ES  
KORNYEZETVEDELEM in Hungarian Apr 91 p 51*

[Article by Laszlo Orosz: "Transgenic Insertion-Cloning-Endomitosis-Gynogenesis-Sexual Inversion; A Possible Technology To Produce Homozygotic Pure Derivative Lines"]

[Text] There can be no dispute about the fact that adhering to and applying the laws of Mendel and the rules of Morganic genetics, that is the combination principles of classical genetics, is the basis for scientifically valid breeding strategies in practical work.

The primary transgenic organism (the body of which was built up directly from that cell into which the alien genes were inserted from outside) is not yet suitable for breeding because it is not yet genetically pure and the degree of inheritance cannot be estimated.

For example, very often this individual is a genetic mosaic, that is the body of it is not built up of cells with the same gene assortment. It will be capable of "transgenic" hereditary transmittal only if the cells of the tissues producing the reproductive cells contain it. The

transgene can be built into a number of individuals, but in different chromosomes and on the most varied places on these chromosomes. It cannot be excluded that two or more transgenes will be built into different places on the same chromosome. In addition, the insertions affect different places on the homologous chromosomes of paternal and maternal origin, so that every individual insertion creates a "heterozygote" locus. Then meiotic division, in accordance with Mendel's third law and the crossing over laws: "Divides" the transgenic copies and puts them into the reproductive cells. Precisely for this reason it is important to establish the number of transgenic copies built into the chromosomes (and possibly their locations) in order to estimate the number and ratio of the types of reproductive cells. Knowing this, and adhering to the Mendelian laws and crossing schema, we may, in theory, get, after many (possibly very many) generations, to a homozygotic breeding stock carrying the transgene. The primary transgenic individual is the subject of many analytical investigations, more than one of which may involve its sacrifice. And this might mean losing the breeding source as well. Cloning alleviates the problem for with its aid we can prepare genetically perfectly identical "copies" of the original individual so that some can be sacrificed for the studies and some will remain for further breeding.

Fish again show their advantageous side in the further breeding, and from three points of view. The phenomena known as endomitosis and gynogenesis and the possibility of sexual inversion bring into visible proximity the dream of transgenic homozygotic breeding. The final haploid products of the meiotic division (and gamete differentiation) in the embryonic tissue of the primary transgenic female fish are roe which can develop, thanks to endomitosis, into a diploid zygote without fertilization by male reproductive cells. From these zygotes come a female individual which is homozygotic for the transgene (or genes) and every other gene and from the eggs of this individual one can grow many identical and homozygotic sisters. But to do this one must make use of another process well known in the propagation biology of fishes, gynogenesis. Gynogenesis, like endomitosis, leads to a diploid zygote from the female egg cell without fertilization. Genetically, however, the two diploidizations involve entirely different things; endomitosis is based on a failure of the chromosomes to migrate while gynogenesis is based on a melding of two haploid cells—the "half tetrad." Endomitosis is a rare phenomenon but gynogenesis can be produced effectively en masse. By adhering to the sequence endomitosis then gynogenesis—and not vice versa!—we can get to a daughter generation of a large number of homozygotic "twins." Then we take a few of them and make them into males with the aid of sexual inversion, well known among fish. At this point we have reached our goal: We have genetically perfectly identical homozygotic males and females, we can fertilize vast numbers of eggs from the latter with the sperm of the former and get vast numbers of progeny. The progeny will always be female so sexually inverted

males must be produced again and again. This, however, is a practice already introduced in large scale fish production.

The reason I have given in such detail my views about the above (imagined) strategy is quite simple; the "Horvath-Orban" research team at Godollo has at hand at a professional level the entire arsenal for this process. And why is the imagined technology, the magic, Hungarian? Because going beyond the transgenic program the domestic intellectual contribution to the discovery and application of gynogenesis has been very significant; Andras Nagy, Vilmos Csanyi, Laszlo Horvath, Miklos Bercsenyi and Janos Bakos, professors and researchers from the ELTE, GATE and HAKI, have enriched the knowledge about the development and breeding of fish with internationally famous discoveries and procedures known around the world.

## COMPUTERS

### Hungary: Consortium To Buy Bankrupt Videoton Formed

92WS0016A Budapest HETI VILAGGAZDASAG  
in Hungarian 14 Sep 91 pp 101-102

[Article by Pal Reti: "A Quadruple Hit; Bid for Videoton"]

[Text] It is barely a month since they reported the liquidation of long-suffering Videoton, and the fate of the firm seems to have already taken a new turn. Four Hungarian "industrial magnates" would be inclined to undertake the reformation of the bankrupt giant state enterprise, but for the time being the representative of the state has rejected the offered sacrifice.

Zsolt Harsanyi (Centroinvest, Ltd.), Gabor Szeles (Muszertechnika [Instrument Technology] Company), Geza Kelemen (Controll Company) and Andras Laszlo (Co-Nexus Company) have formed a consortium to buy Videoton. They are not doing so as chief stockholders or directors general of some of the largest private enterprises in Hungary but rather as private individuals. The Rehabilitation Organization, appointed by the court to liquidate Videoton, rejected their first takeover offer so the entrepreneurs called a press conference at which they first called attention to the importance of national capital. At the same time—citing business confidentiality—not a word was said about with what partners or for how much of what money they intended to acquire the giant enterprise which is being liquidated, or what they would do with it if they got it. All they would say was, using the formulation of Gabor Szeles, that even today they regarded this erstwhile "jewel" of Hungarian industry as a national treasure which must be kept together with national ownership.

It also came out that in their first offer they planned to buy the sinking flagship of Hungarian electronics not with ready money but rather with some sort of "bond

payment." Laszlo Redei, chief of the Rehabilitation Organization, let HVG [HETI VILAGGAZDASAG] in on the details of the offer: "The consortium wanted to pay with 25 year term bonds from which the counter-value of Videoton would begin to flow in as ready money after 15 years." This would have meant a takeover price of several hundred million forints recalculated into so-called "present value." The chief creditors, to whom the four also sent their offer, allegedly laughed at it, although today their opinion is pertinent only to the extent that they may appeal against the liquidator after the fact if they feel that he did not sell the assets of Videoton at the highest possible price. "But the law does not say," Laszlo Redei said, "which the largest bid is, one which offers a hundred for immediate payment or one which, let us say, promises 150 with a five year payment time limit."

According to observers the four Hungarian entrepreneurs timed their offer perfectly. If they had come out with it a few weeks earlier, they also would have had to talk with the creditors of the Videoton plants still being reorganized concerning a debt of 27 to 30 billion forints. But in the middle of August, they began to liquidate the six largest members of the Videoton group, which combined one state enterprise and 21 companies. The six largest members having in practice ownership rights over the others. Thus, any future owners have nothing to do with the creditors now as the liquidator will satisfy their claims. They cannot count on much. A precise survey of the property of Videoton has not yet been prepared, but according to Laszlo Redei the value of its assets—buildings, machines, materials, etc.—may be about 10 billion forints; the four national entrepreneurs, however, estimate it at no more than 5 to 7 billion. So the creditors may see at most 15 to 20 percent of their money.

And the bid came just in time from another point of view. In another few weeks there may be nothing to discuss because the "carrying away of the enterprise may become irreversible," according to the four, who would like to close within two months the Videoton affair, which has been dragging on now for years.

Redei is counting on a more leisurely schedule. According to him it is not yet entirely certain that precise balance and property data and descriptions of what their assets might be used for will be received from the individual Videoton enterprises by the end of October. Only after that can a competition be announced for purchase of the "legacy." So it may be the end of the year before we know whose Videoton will be. Nor is it certain that it will remain in one piece. According to Redei the Rehabilitation Organization will insist only that technological units—such as TV manufacture—not be broken up, but they would have no objection if the different profiles of Videoton were to get into the hands of different firms, if more could be gotten for it in this way.

As they said at the already mentioned press conference the four businessmen fighting to keep it together (among other things) were not quelled by the first rejection. They are working on a new offer which, they say, will also



contain the payment of ready money. According to Andras Laszlo, the money procurer for the consortium, getting together a loan of possibly several tens of millions of dollars is progressing well, because "foreign investors are mobilized on hearing the names of the big four." And they will be needed too because—as came out later—at the moment the four do not want to spend a penny of their own money for Videoton, beyond the 5 million they have spent thus far on preparations and an additional 5 to 10 million which they will be forced to spend still. Zsolt Harsanyi, who told HVG the rest, added that they want to pay the entire takeover price out of foreign loans, and so they are thinking that in the first stage, under this heading, they will have to give about a 30 percent ownership share to the investors.

Gabor Szeles, who is responsible for developing a business plan and enterprise structure for the firm to be purchased, said that they would like to reorganize Videoton into a holding company which would bring together eight to 12 completely independent profit centers. The Western capital would go first into the holding company and later into the individual member enterprises in such a way that the foreign partner might obtain a majority share in the latter, but the former would remain in majority national ownership. This organizational scheme—which, according to Gabor Szeles' own admission, bears a spooky resemblance to the thinking of the former Videoton chief Janos Kazsmer, highly respected by Szeles, thinking which ricocheted as it was being realized—would make it possible for the Western capital not to be disturbed by capital which might come from the East, which might be interested in continuing certain military industry activities.

The quartette promises that the renewed Videoton—it is not at all certain that this will be its name—would provide work in the district for 15,000 people, as opposed to the present 12,000 and those completely without prospects in the event of liquidation. Many of them might be independent entrepreneurs doing piece work for the large enterprise.

Except for the rejected offer of the four no other customer has applied in writing to the Rehabilitation Organization, but Laszlo Redei does know of other potential bidders as well.

#### **Hungarian Computer Industry Issues Discussed**

92WS0043A Budapest **COMPUTERWORLD/**  
**SZAMITASTECHNIKA** in Hungarian 12 Sep 91 p 13

[Interview with Tamas Rammacher by Peter Sz.-Szalay: "The New Broom Doesn't Sweep"; first paragraph is **COMPUTERWORLD/SZAMITASTECHNIKA** introduction]

[Text] One of the most interesting personal news items of the past year was that Tamas Rammacher had moved from Softinvest to Controll. Our journal reported at the time concerning the reasons for the decision of the director general (CW-SZT, 90/37). Now we asked him

what had he done thus far in his new post, how he was dividing up the tasks and sphere of authority with Geza Kelemen, and whether he still felt nostalgia for his own "child," Softinvest.

**COMPUTERWORLD/SZAMITASTECHNIKA:** Your old firm closed the past year with modest results. This appears to justify the opinion of those according to whom you left a sinking ship. The captain is the first to leave....

**Rammacher:** There is nothing to debate about here because if someone has this opinion it would be in vain for me to state the contrary. I left Softinvest with a very heavy heart, in part because I regarded it as my own, and I had spent ten very successful years of my life there. But the offer from Controll was really alluring for me because I could try my talents in an undertaking working in a larger area of computer technology. This was my chief motive.

In addition, those who regard Softinvest as a sinking ship are not right. Last year was difficult for virtually every undertaking, but there are already signs of an upswing this year. The first half year results of my former firm prove this too.

**COMPUTERWORLD/SZAMITASTECHNIKA:** So consciously or unconsciously you are still watching Softinvest?

**Rammacher:** Naturally, and in both ways!

**COMPUTERWORLD/SZAMITASTECHNIKA:** But disregarding for now the mass of home tasks you must also watch the big competitors, Muszertechnika [Instrument Technology] and Microsystem.

**Rammacher:** This is obvious, but I believe—and the question suggests it—that many exaggerate the conflicts among the large domestic computer technology undertakings, as if they were waging a death struggle against one another. It is indisputable that there are conflicts of interest on the market, but I consider more essential those common interests which prompt us to cooperate.

**COMPUTERWORLD/SZAMITASTECHNIKA:** You have common enemies....

**Rammacher:** The term enemy may be an exaggeration, but there are dishonest competitors on the market. Among these I would list the "one deal" undertakings, those which get a large lot of equipment very cheaply somewhere in the Far East, sell it here at a dumping price and then disappear—fog in front and fog behind. No guarantee, no parts supply, the customer can go whistle for them. These people break up and ruin the market and gnaw away at trust in honest people.

Our common enemies are the large Western firms which have cast themselves on the Hungarian market with great vehemence. Only big companies can withstand this challenge, and they only if they try jointly to protect their elementary interests.



**COMPUTERWORLD/SZAMITASTECHNIKA:** Are you thinking of some sort of common action or defense by the domestic undertakings?

**Rammacher:** No, more precisely only to the extent that we cooperate in trying to influence those who formulate and approve the laws affecting us, so that we can act jointly in the interest of honest tenders and against the dishonest competitors. These are our common elementary interests. We cannot permit the competition, the rules of the market, the frameworks within which we operate, to develop without us, and we must undertake a role in adherence to them too!

The situation is different with the strategy and tactics of development or perhaps simply survival. Every undertaking must work these out for itself. It is obvious that we cannot compete with the big Western competitors. We must hold our market positions by cooperating with them. Mixed enterprises, distributor contracts, and resale agreements may be forms of this. The essential thing is that the Hungarian partner not get into a subordinate position in these contacts, because the foreign partner—after a few years—will buy the domestically owned part too. So in a mixed enterprise there must be an effort to have the domestic added value be as great as possible in the product going on the market. In the case of software and hardware, this can be adaptation, preparation of peripherals, applications software, and etc. What is important is that the Hungarian partner is strengthened in the course of the cooperation, and thus is able to resist the buy-out efforts of the foreign partner.

**COMPUTERWORLD/SZAMITASTECHNIKA:** Obviously you agree with Geza Kelemen in the application of these principles. But this is not the only reason you took over the director general seat at Controll. The new broom must also implement organizational and structural changes. Coming from outside you can sweep where the founding president would not gladly do so.

**Rammacher:** Well, the new broom received no such task, and there was not a single victim. My commission—from this viewpoint—was to create a new, modern information and control system. During its development Controll grew beyond what could be controlled out of head or pocket. The old leaders and members of the firm—including the president, Geza Kelemen—although they knew that this change had taken place still felt capable of following things in their head in the course of their daily work. So the strange situation arose where although everyone agreed with the necessity of creating strict administrative discipline it took a man coming from outside to implement this consistently. I set about

the task without prejudices. It became natural for my colleagues that everything had to be written down for me because neither half words—from which they felt they understood one another—nor whole ones were enough to keep me informed. This apparently extra work led to a real saving of time—thanks to the outstanding infrastructure, even the gate keeper has a computer. So we had more and more energy left for real value producing activity, and every day we know the status of the firm precisely.

**COMPUTERWORLD/SZAMITASTECHNIKA:** What do the computers say, what is the status?

**Rammacher:** In all probability we will increase our turnover this year. The market was unusually lively in the first two months and if—as usual—the second six months are stronger then we will have a very nice year. We have two to three times the number of customers as last year at this time—true, they are buying smaller orders—and I consider it especially encouraging that the new undertakings are buying computers as they start up, so there are a number of deals.

**COMPUTERWORLD/SZAMITASTECHNIKA:** It appears that your thinking in connection with the new tasks has worked out, the international contacts of Controll have developed well. Do you feel satisfied?

**Rammacher:** From every viewpoint. In the first place because I can be the defining man in a more complex organization, and in the second place because it appears that things are going well. Among the successes I must mention the mixed enterprise formed with HP. We have ample tasks within the framework of this; we are participating in the venture not as a simple merchant. As was said above, we are strengthening ourselves in the course of the cooperation.

**COMPUTERWORLD/SZAMITASTECHNIKA:** We have not yet talked about it—although it was the starting point for our interview—about the division of labor between Geza Kelemen and yourself?

**Rammacher:** According to the agreement, I am the leader of the Controll Company, with full authority. Geza Kelemen deals with new undertakings, which are held together by Controll Holding. We will go before the public with these in the fall. I think you will have to put these questions to him. For my part I can report one thing new, that we will soon move to Budaors, into our new 4,000 square meter office building, beside the airport. Only our trade center will remain here on Ulloi ut. In the new Controll headquarters we will be able to receive our ever increasing number of business partners in conditions worthy of our good name.

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